	Type	Hits	Search Text	DBs	Time Stamp
1	BRS	120	380/231.ccls.	USPAT; US-PGPUB; IBM_TDB	2004/09/22 16:47
2	BRS	12	("4358672" | "4506387" | "4593337" | "4890320" | "4945563" | "4947429" | "5046090" | "5051822" | "5060079" | "5070400" | "5081680" | "5291554").PN.	USPAT	2004/09/22 16:22
3	BRS	32	5400402.URPN.	USPAT	2004/09/22 16:22
4	BRS	22	380/231.ccls. and (wave or $1wav)	USPAT; US-PGPUB; IBM_TDB	2004/09/22 16:47
5	BRS	1	5796828.pn.	USPAT; US-PGPUB; IBM_TDB	2004/09/23 08:34
6	BRS	46	portable adj media adj player	USPAT; US-PGPUB; IBM_TDB	2004/09/23 09:21
7	BRS	1308	compact$2 near2 (hard adj (disk or drive))	USPAT; US-PGPUB; IBM_TDB	2004/09/23 09:26
8	BRS	3	(compact$2 near2 (hard adj (disk or drive))).ti.	USPAT; US-PGPUB; IBM_TDB	2004/09/23 09:29
9	BRS	35	($4port$4 near2 (hard adj (disk or drive))).ti.	USPAT; US-PGPUB; IBM_TDB	2004/09/23 10:17
10	BRS	10	media adj player and (mp3 same mpeg same (wave or .wav))	USPAT; US-PGPUB; IBM_TDB	2004/09/23 10:22
11	BRS	54	(mp3 same mpeg same (wave or .wav))	USPAT; US-PGPUB; IBM_TDB	2004/09/23 10:35
12	BRS	240	(mp3 same mpeg same (wave or wav))	USPAT; US-PGPUB; IBM_TDB	2004/09/23 10:35
13	BRS	8	(mp3 same mpeg same (wave or wav)) and pirate	USPAT; US-PGPUB; IBM_TDB	2004/09/23 10:36
14	BRS	110	(mp3 same mpeg same (wave or wav)) and download	USPAT; US-PGPUB; IBM_TDB	2004/09/23 10:36

US005796828A

United States Patent [19]

Tsukamoto et al.

[11] Patent Number: 5,796,828

[45] Date of Patent: Aug. 18, 1998

[54] **CONTROLLED-ACCESS BROADCAST SIGNAL RECEIVING SYSTEM**

[75] Inventors: **Junichi Tsukamoto**, Tokyo; **Koichi Goto**; **Shinichi Fukushima**, both of Kanagawa, all of Japan

[73] Assignee: **Sony Corporation**, Tokyo, Japan

[21] Appl. No.: **499,332**

[22] Filed: **Jul. 7, 1995**

[30] **Foreign Application Priority Data**

Jul. 8, 1994 [JP] Japan 6-180637

[51] **Int. Cl.**[6] **H04N 7/167**; H04L 9/00; H04L 9/32

[52] **U.S. Cl.** **380/10**; 380/4; 380/5; 380/9; 380/23; 380/49; 380/50

[58] **Field of Search** 380/4, 5, 9, 10, 380/23, 25, 49, 50

[56] **References Cited**

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Primary Examiner—Bernarr E. Gregory
Attorney, Agent, or Firm—Frommer Lawrence & Haug LLP; William S. Frommer

[57] **ABSTRACT**

An apparatus and method for transferring from a broadcaster to a receiver a limited reproduction right in data. A signal indicating the limited reproduction right is transmitted by the broadcaster and stored by the receiver with the data. The receiver reproduces and processes the data as a function of this signal.

40 Claims, 8 Drawing Sheets

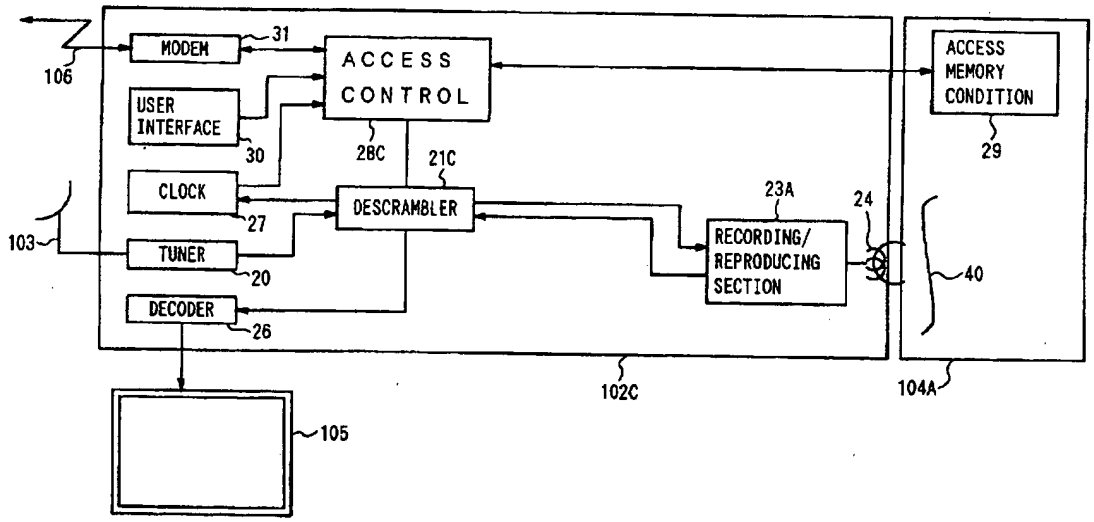
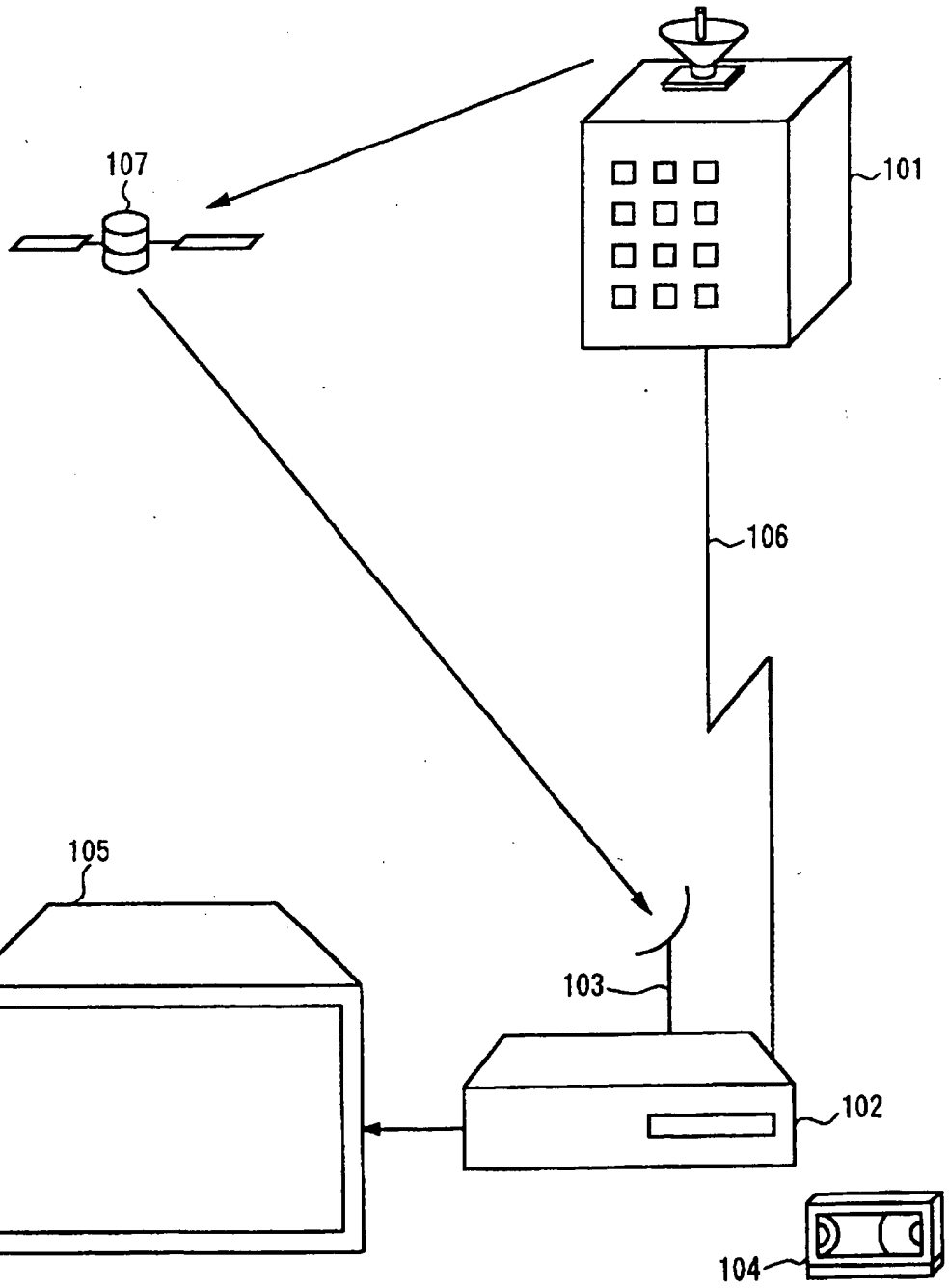


Fig. 1



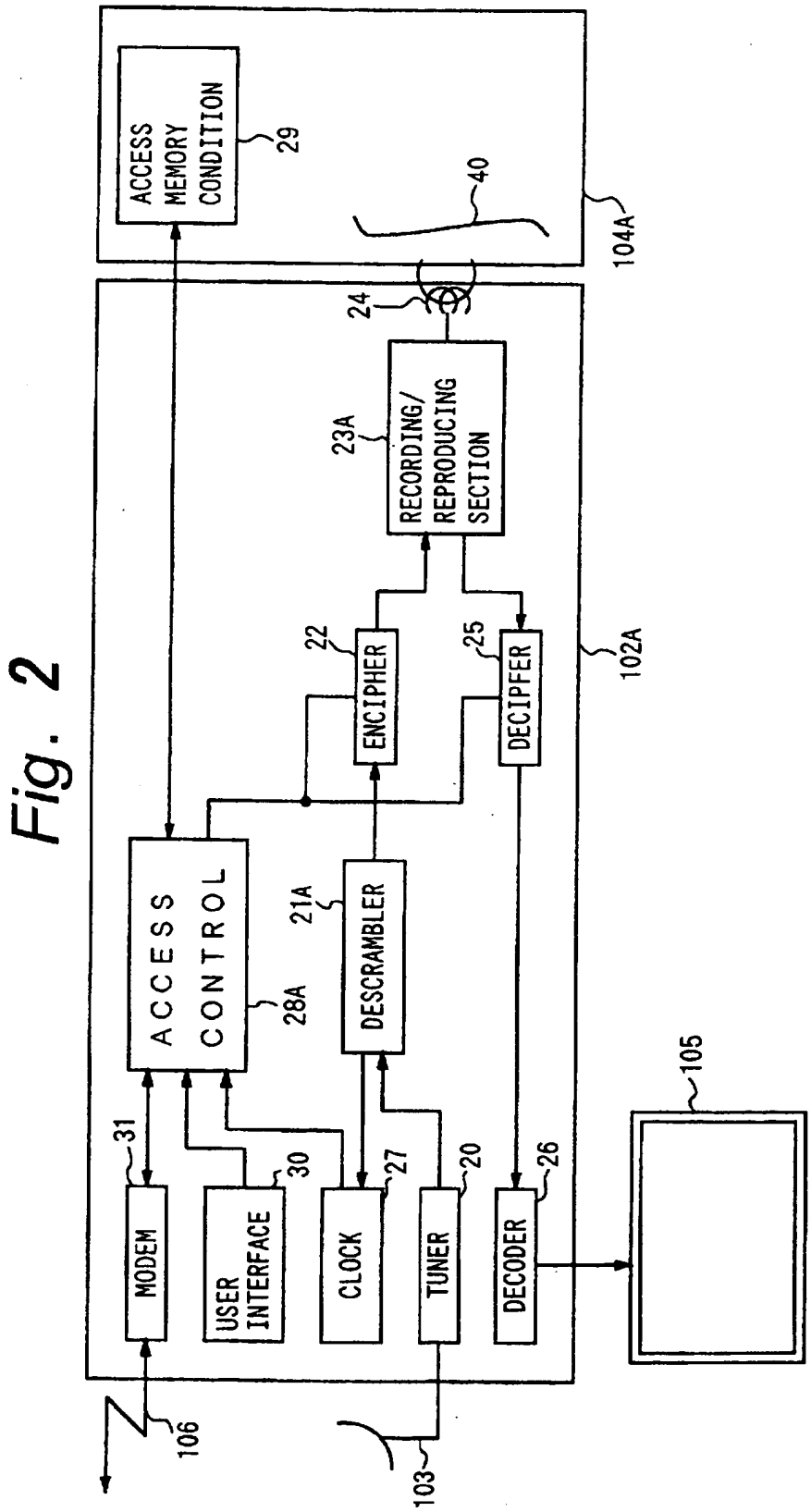
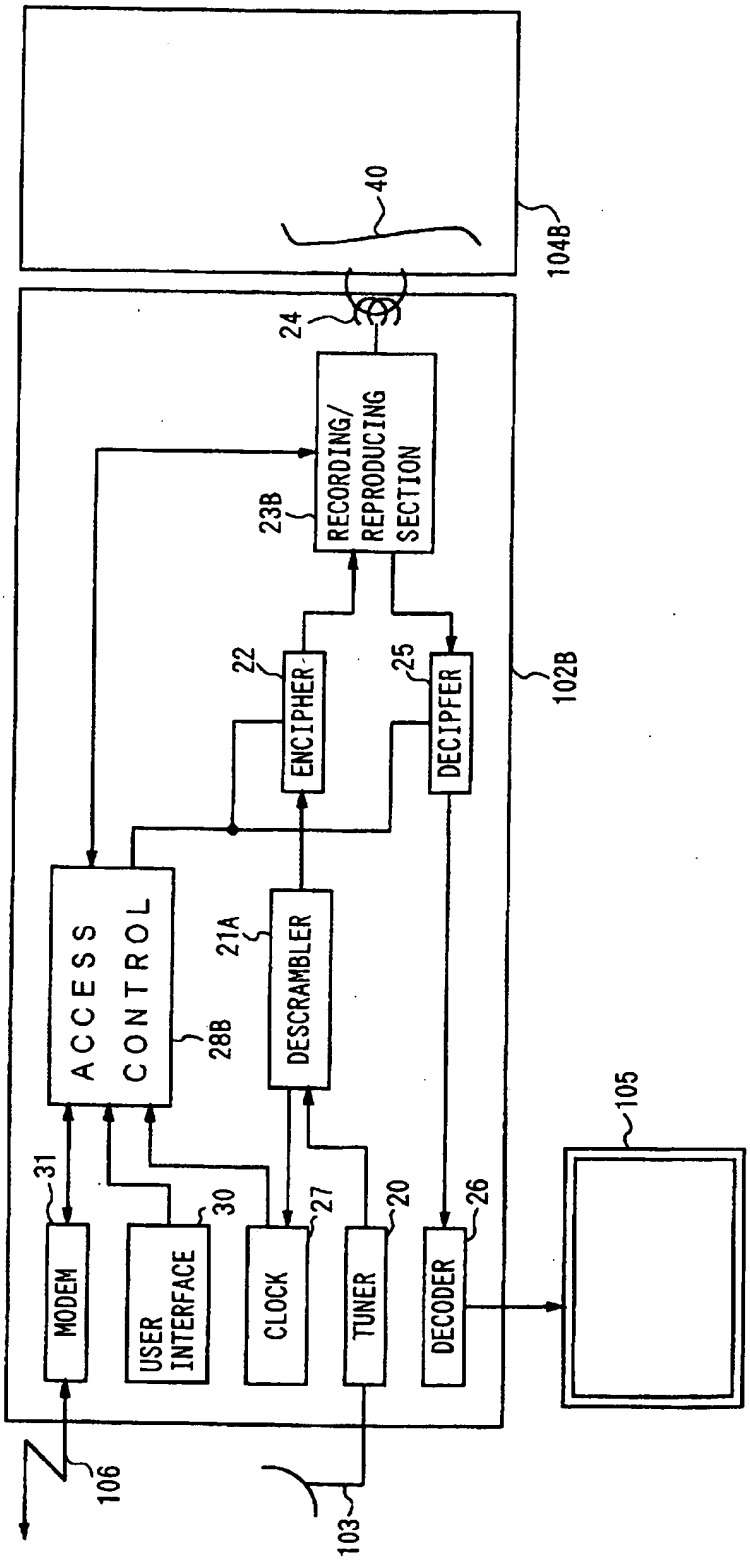

ACCESS MEMORY CONDITION
29
40
104A
24
23A
RECORDING/ REPRODUCING SECTION
22
ENCIPHER
25
DECIPFER
102A
ACCESS CONTROL
28A
21A
DESCRAMBLER
105
31
30
27
20
26
MODEM
USER INTERFACE
CLOCK
TUNER
DECODER
106
103

Fig. 2

Fig. 3


40
104B
24
RECORDING/ REPRODUCING SECTION
23B
22
ENCIPHER
25
DECIPFER
102B
ACCESS CONTROL
28B
21A
DESCRAMBLER
105
31
30
27
20
26
MODEM
USER INTERFACE
CLOCK
TUNER
DECODER
106
103

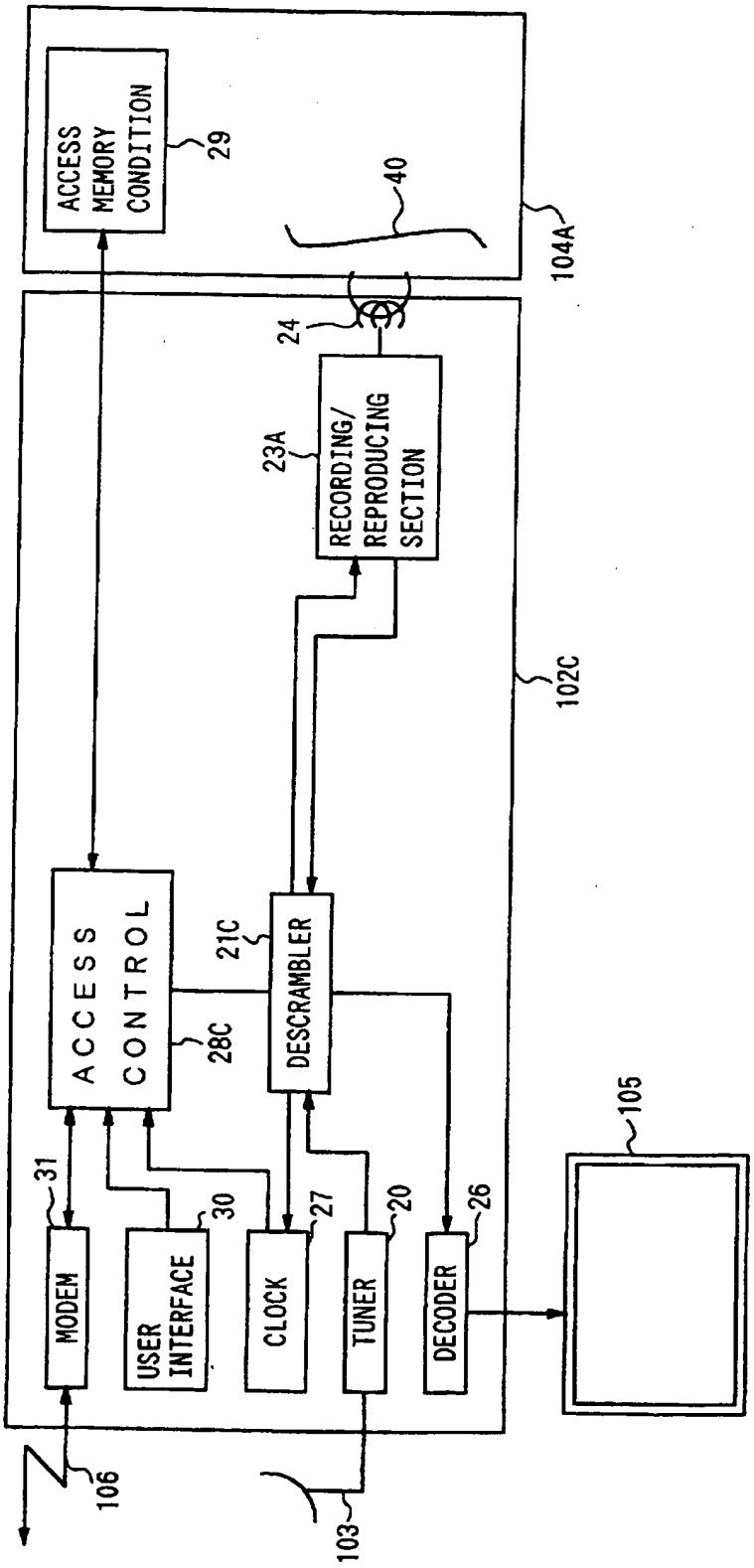

ACCESS MEMORY CONDITION
29
40
104A
24
23A
RECORDING/ REPRODUCING SECTION
102C
ACCESS CONTROL
28C
21C
DESCRAMBLER
105
31
30
27
20
26
MODEM
USER INTERFACE
CLOCK
TUNER
DECODER
106
103

Fig. 4

Fig. 5

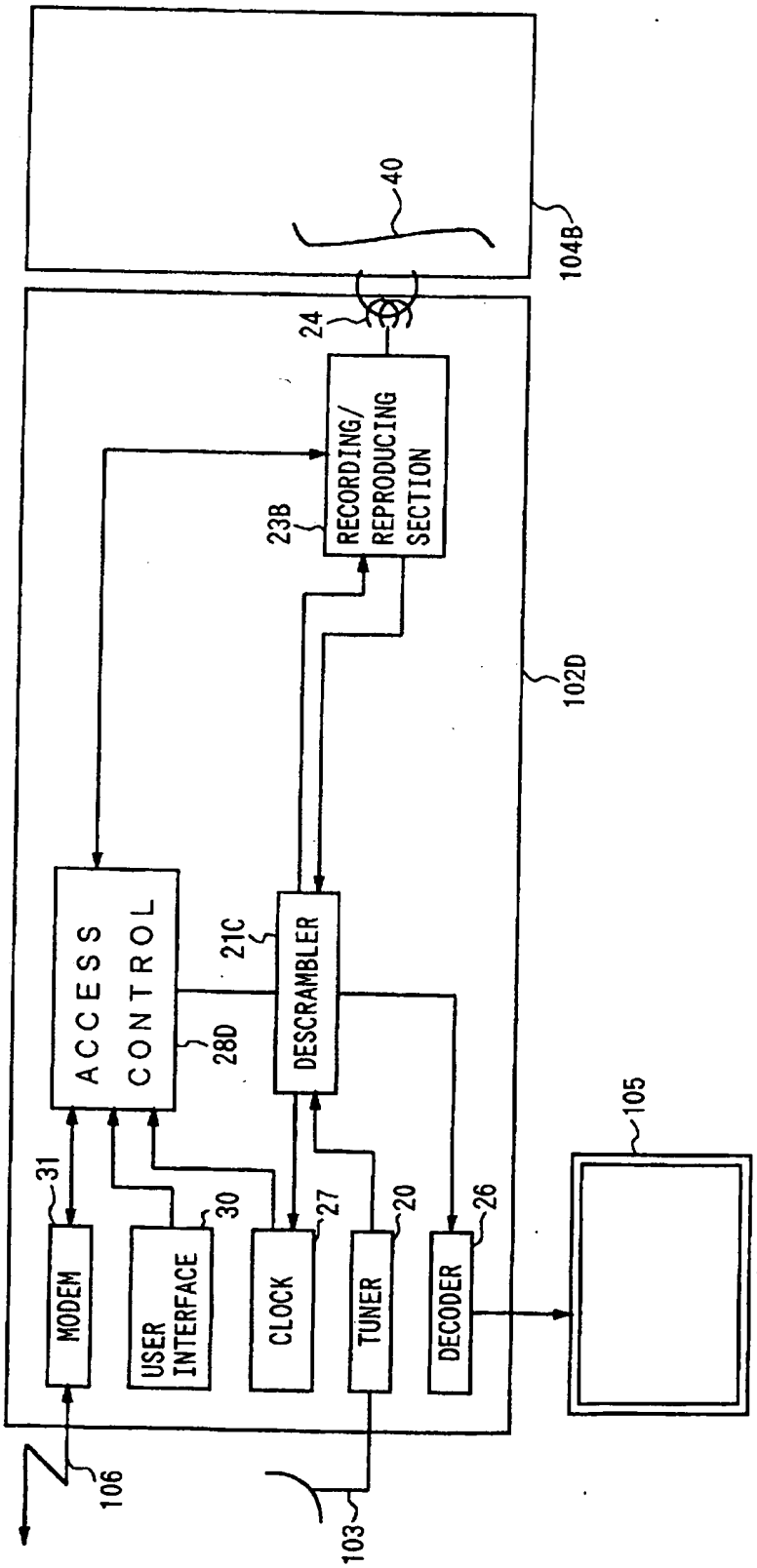

40
104B
24
RECORDING/ REPRODUCING SECTION
23B
102D
ACCESS CONTROL
21C
DESCRAMBLER
28D
105
31
30
27
20
26
MODEM
USER INTERFACE
CLOCK
TUNER
DECODER
106
103

Fig. 6

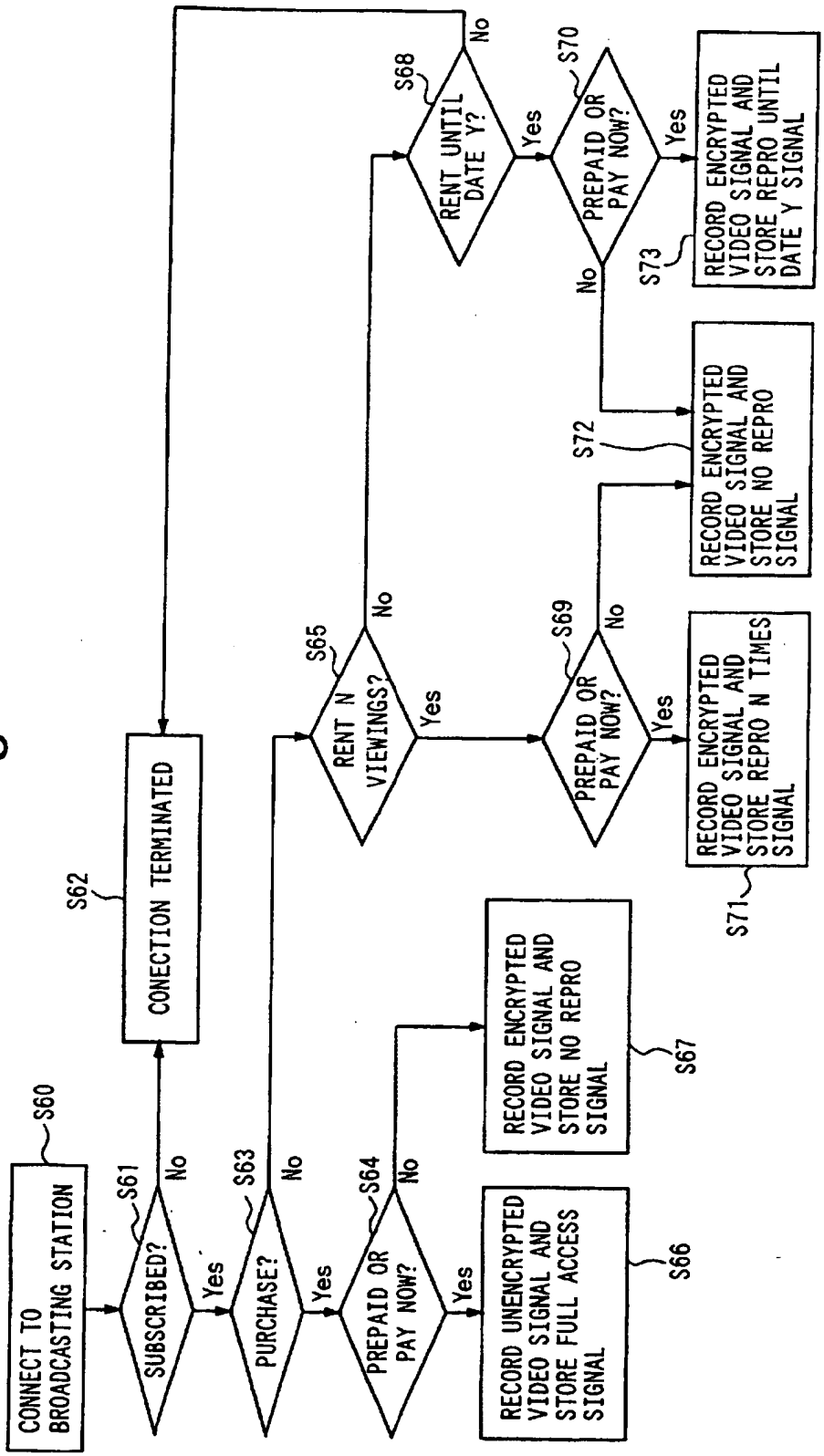

CONNECT TO BROADCASTING STATION
S60
SUBSCRIBED?
S61
No
Yes
CONECTION TERMINATED
S62
PURCHASE?
S63
No
Yes
PREPAID OR PAY NOW?
S64
No
Yes
RECORD UNENCRYPTED VIDEO SIGNAL AND STORE FULL ACCESS SIGNAL
S66
RECORD ENCRYPTED VIDEO SIGNAL AND STORE NO REPRO SIGNAL
S67
RENT N VIEWINGS?
S65
No
Yes
PREPAID OR PAY NOW?
S69
No
Yes
RECORD ENCRYPTED VIDEO SIGNAL AND STORE REPRO N TIMES SIGNAL
S71
RENT UNTIL DATE Y?
S68
No
Yes
PREPAID OR PAY NOW?
S70
No
Yes
RECORD ENCRYPTED VIDEO SIGNAL AND STORE NO REPRO SIGNAL
S72
RECORD ENCRYPTED VIDEO SIGNAL AND STORE REPRO UNTIL DATE Y SIGNAL
S73

Fig. 7A

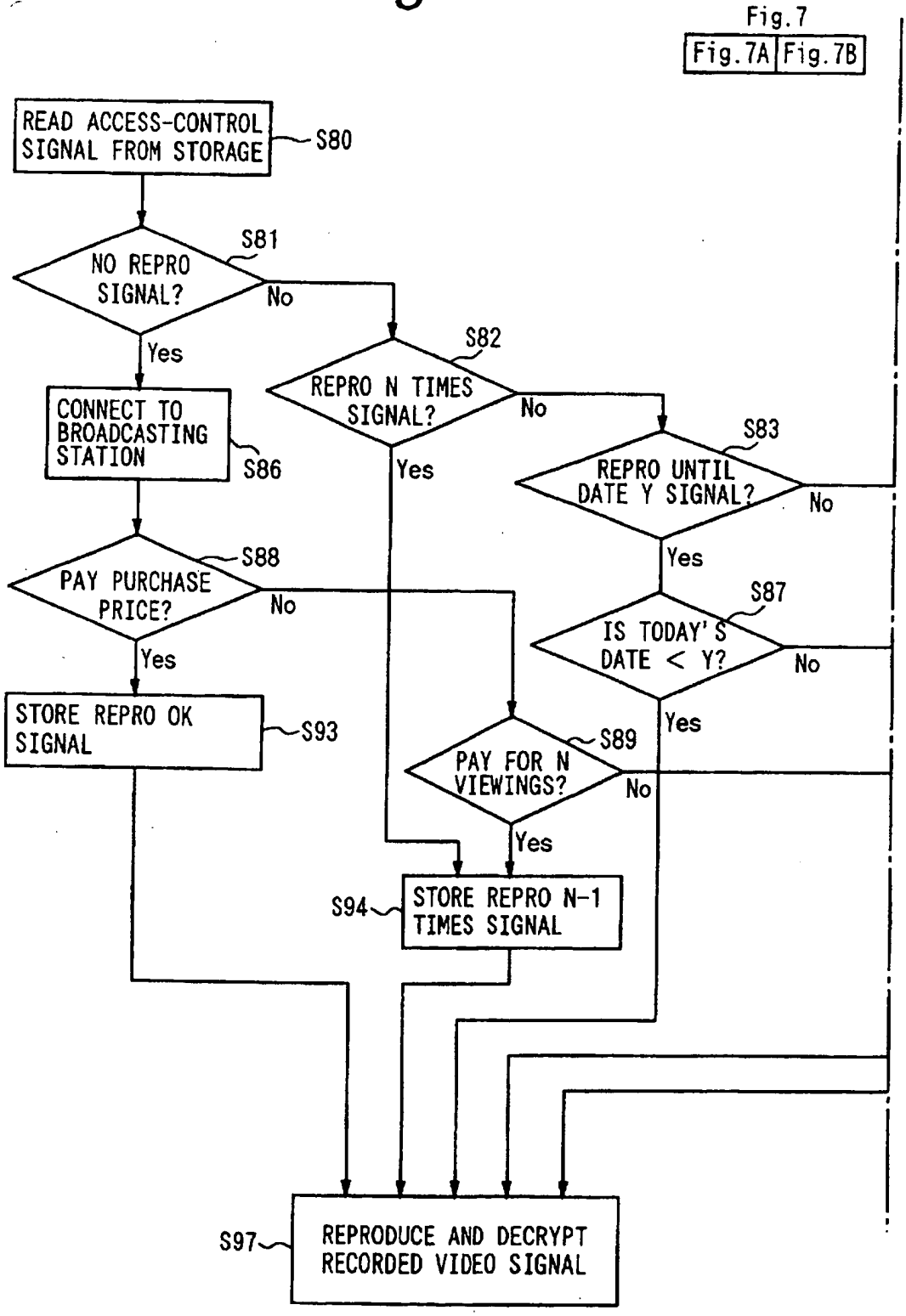
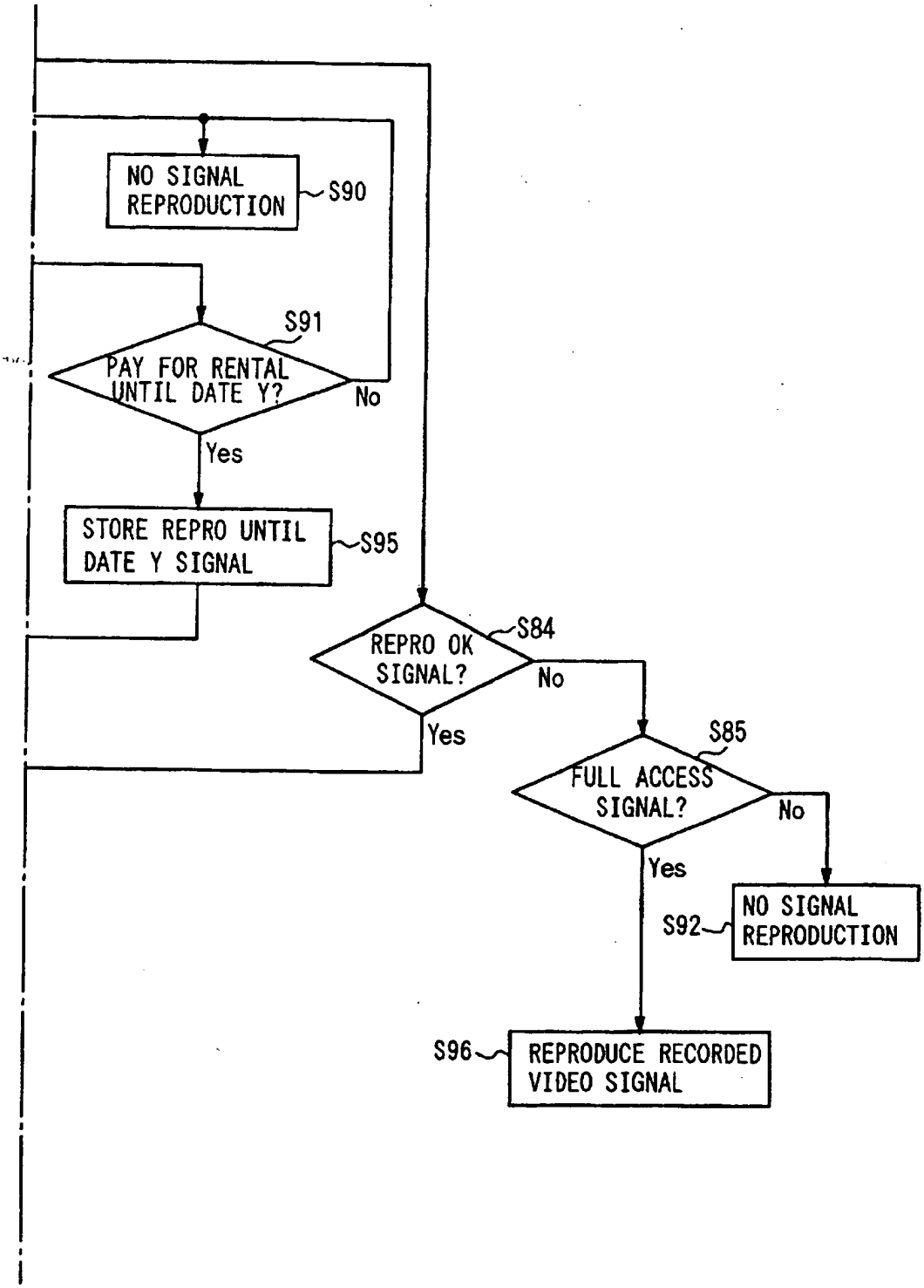


Fig.7
Fig.7A
Fig.7B
READ ACCESS-CONTROL SIGNAL FROM STORAGE
S80
NO REPRO SIGNAL?
S81
No
Yes
REPRO N TIMES SIGNAL?
S82
No
Yes
CONNECT TO BROADCASTING STATION
S86
REPRO UNTIL DATE Y SIGNAL?
S83
No
Yes
PAY PURCHASE PRICE?
S88
No
Yes
IS TODAY'S DATE < Y?
S87
No
Yes
STORE REPRO OK SIGNAL
S93
PAY FOR N VIEWINGS?
S89
No
Yes
S94
STORE REPRO N-1 TIMES SIGNAL
S97
REPRODUCE AND DECRYPT RECORDED VIDEO SIGNAL

Fig. 7B


NO SIGNAL REPRODUCTION
S90
S91
PAY FOR RENTAL UNTIL DATE Y?
No
Yes
STORE REPRO UNTIL DATE Y SIGNAL
S95
S84
REPRO OK SIGNAL?
No
Yes
S85
FULL ACCESS SIGNAL?
No
Yes
S92
NO SIGNAL REPRODUCTION
S96
REPRODUCE RECORDED VIDEO SIGNAL

CONTROLLED-ACCESS BROADCAST SIGNAL RECEIVING SYSTEM

BACKGROUND OF THE INVENTION

This invention relates to video data communication in which a limited reproduction right in video data is transferred between a broadcaster and a receiver.

Commonly, video programming is transmitted from a broadcaster to a user via a satellite or cable communications system. In some systems, users are able to request, and broadcasters provide, select video programming through the use of individually addressable decoding receivers. The user's decoder is activated upon receipt of the user's address which is transmitted along with the requested video programming.

The drawback of such systems is that the user is often able to record the requested video programming for later reproduction. This later reproduction occurs without any royalty payment to the broadcaster or other holder of copyrights in the video programming. Further, the recorded video programming can be disseminated by the user to others for additional reproductions without corresponding royalty payments.

OBJECTS AND SUMMARY OF THE INVENTION

An object of the present invention is to provide a system for the transfer between a broadcaster and a user of a limited reproduction right in transmitted data.

Another object of the present invention is to enable a user to request from a broadcaster a particular limited reproduction right in a selected video program.

Yet another object of the present invention is to prevent the reproduction of transmitted data by a user without adequate payment for each reproduction.

In accordance with the present invention, an apparatus for receiving, recording, and reproducing data signals is provided. A receiver receives transmitted data signals along with an access-control signal, the latter serving to control subsequent processing of the received data signals. The processed data signals are recorded in a first storage medium, and the access-control signal is stored in a second storage medium. When the processed data signals subsequently are reproduced from the first storage medium the access-control signal is retrieved from the second storage medium, and is used to control the reprocessing of the reproduced data signals.

The above, and other objects, features and advantages of the present invention will become apparent from the following detailed description of illustrative embodiments when read in conjunction with the accompanying drawings in which the same components are identified by the same reference numerals.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic diagram of a satellite broadcast system in which the present invention finds ready application;

FIG. **2** is a block diagram of a controlled-access broadcast digital video signal receiving system according to one embodiment of the present invention;

FIG. **3** is a block diagram of a controlled-access broadcast digital video signal receiving system according to another embodiment of the present invention;

FIG. **4** is a block diagram of a controlled-access broadcast digital video signal receiving system according to a further embodiment of the present invention;

FIG. **5** is a block diagram of a controlled-access broadcast digital video signal receiving system according to yet another embodiment of the present invention;

FIG. **6** is a flow diagram illustrating a communication and processing operation controlled by the controller of the controlled-access broadcast digital video signal receiving system of FIG. **2**; and

FIG. **7** is another flow diagram illustrating another processing operation controlled by the controller of the controlled-access broadcast digital video signal receiving system of FIG. **2**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. **1** illustrates a satellite broadcast system incorporating a controlled-access broadcast signal receiving system **102** according to the present invention. As explained in the following, it is preferred that the controlled-access broadcast signal receiving system **102** be specifically adapted to receive and process digital video data. Nevertheless, it should be appreciated that this system can be modified to accommodate other digital or analog signals without departing from the scope of the invention. As it is understood that the system can easily be implemented to accommodate other types of data, the following explanation is specifically directed towards a controlled-access broadcast digital video signal receiving system **102**.

The satellite television broadcasting system comprises a broadcasting station **101**, controlled-access broadcast digital video signal receiving system **102**, an antenna **103**, a video display **105**, a communication link **106**, and a satellite **107**. Broadcasting station **101** broadcasts video signals and access-control signals to the controlled-access broadcast digital video signal receiving system **102** which processes the video signals as a function of the access-control signals.

Broadcasting station **101** transmits video and access-control signals to receiving system **102** via communication link **106**, satellite **107**, or both. Communication link **106** is a signal transmission medium that couples broadcasting station **101** and receiving system **102**. Preferably, communication link **106** comprises a conventional telephone line. Alternatively, communication link **106** includes any of a number of other transmission media, such as a land-based broadcast system, a cable television system, a fiber optic network or the like.

Satellite **107** is a satellite broadcast signal relay station that receives signals from broadcasting station **101** and relays the signals to antenna **103**. Antenna **103** receives signals from satellite **107** and supplies the signals to receiving system **102**. Alternatively, satellite **107** can be replaced by any of a number of other transmission media, such as a land-based broadcast system, a cable television system, a fiber optic network or the like.

Receiving system **102** receives video signals and access-control signals supplied by broadcasting station **101** and processes (e.g. descrambles, decodes, and records) the signals. Typically, video signals are recorded on a storage medium and subsequently reproduced for display. Alternatively, video signals are recorded on a storage medium and processed for display to a user substantially simultaneously. Access-control signals are stored in a memory or, alternatively, recorded on a storage medium which may be the same storage medium on which the video

signals are recorded. In a preferred embodiment, receiving system **102** is adapted to receive a storage cassette **104** containing a tape on which video and access-control signals are recorded. Alternatively, storage cassette **104** comprises a tape for storing video signals and a separate memory, such as a memory chip included therein, for storing access-control signals. In other embodiments, receiving system **102** is adapted to receive any of a number of other storage media, such as a video disc, a magnetic media diskette, a compact disc or the like. Video display **105**, which preferably is a conventional display device, is coupled to and receives video signals from receiving system **102** for display to a user.

In a preferred recording mode of operation, broadcasting station **101** transmits video signals to satellite **107** which relays the signals to antenna **103** from which the video signals are coupled to receiving system **102**. Also, broadcasting station **101** transmits access-control signals through communication link **106** to the receiving system. Receiving system **102** processes and records the video signals as a function of the access-control signals.

In a preferred reproduction mode of operation, the receiving system retrieves the previously stored access-control signals and uses those access-control signals to control the reproduction and processing of the previously recorded video signals. The video signals are supplied to video display **105** or to another peripheral device (not shown).

An alternate satellite television broadcasting system according to the present invention comprises each of the elements described above except that only one of communication link **106** and satellite **107** is included. The alternate system is otherwise interconnected as in the above-described embodiment. Through the single transmission medium, broadcasting station **101** transmits both video signals and access-control signals to receiving system **102**.

In another variation, receiving system **102** transmits program requests, payment information, or other signals to broadcasting station **101** through one of the transmission media. Typically, communication link **106** is used for this purpose.

A first embodiment of the controlled-access broadcast digital video signal receiving system **102** according to the present invention is illustrated in FIG. **2** as system **102A**. Receiving system **102A**, is adapted for receiving, descrambling, enciphering, recording, deciphering and decoding digital video signals; and is comprised of a tuner **20**, a descrambler **21A**, an encipherer **22**, a recording/reproducing section **23A**, a decipherer **25**, a decoder **26**, an access controller **28A**, a user interface **30**, and a modem **31**.

Tuner **20** receives input digital video signals, selects particular digital video signals, and supplies the selected signals to descrambler **21A**. Preferably, input digital video signals are satellite broadcast digital video signals acquired by satellite antenna **103** which is coupled to tuner **20**. Alternatively, input digital video signals are acquired from another transmission medium that is coupled to tuner **20**. Preferably, a user controls tuner **20** to select signals from among different input digital video signals. The selected video signals include a time reference signal and a date reference signal.

Descrambler **21A** is coupled to tuner **20** and descrambles scrambled digital video signals supplied therefrom. As is well known in the art, transmitted video signals are commonly scrambled or coded by a signal provider to prevent unauthorized reception of the video signals. Descrambler **21A** supplies an unscrambled version of the digital video signals to encipherer **22**. Further, descrambler **21A** is coupled to a clock **27** to supply the received time reference signal and the date reference signal thereto.

Encipherer **22** is coupled to descrambler **21A**, recording/reproducing section **23A**, and access controller **28A**. When enabled by the access controller, encipherer **22** encrypts, according to an encryption key, descrambled video signals supplied by descrambler **21A** to produce encrypted video signals. The encrypted video signals are supplied to recording/reproducing section **23A** for recording. However, the encrypted video signals cannot be displayed by ordinary means. It is contemplated that the encryption key is prestored in encipherer **22**, or is supplied by access controller **28A**, or is included in the video signals or in the access-control signals supplied by broadcasting station **101**. When disabled by access controller **28A**, encipherer **22** passes descrambled video signals from descrambler **21A** directly to section **23A** without encryption.

Recording/reproducing section **23A**, through a record/playback head **24**, or the like, records on storage medium **40** video signals supplied by encipherer **22**. Section **23A**, through head **24**, also reads previously recorded video signals from storage medium **40** and supplies the reproduced video signals to decipherer **25**. Preferably, section **23A** is a digital video tape recording/reproducing device (VTR) and storage medium **40** is a video tape. However, other types of storage media are contemplated, such as optical, magnetic or magneto-optic disc, solid-state memory, or the like.

Decipherer **25** is coupled to decoder **26** and, when enabled by access controller **28A**, is adapted to decrypt, according to an encryption key, encrypted signals supplied by recording/reproducing section **23A**. It is contemplated that the encryption key is prestored in decipherer **25**, or is supplied thereto by access controller **28A**, or is included in the video signals or the access-control signals supplied by broadcasting station **101**, or is stored in storage medium **40**, or is stored in access condition memory **29**. When disabled, decipherer **25** passes video signals from recording/reproducing section **23A** directly to decoder **26** without decryption.

As is well known in the art, video signals are commonly compressed or otherwise coded to facilitate their transmission through a transmission medium. Decoder **26** decodes such coded digital video signals as reproduced from storage medium **40** to produce uncoded digital video signals which are coupled to video display **105** for display. It is preferred that decoder **26** is adapted to decode digital video signals encoded in accordance with the Moving Picture Image Coding Experts Group (MPEG) standard.

Clock **27** is comprised of a clock device and a date device for tracking the time of day and the calendar date, respectively, known to those of ordinary skill in the art. Clock **27** is coupled to access controller **28A** and supplies time signals and date signals thereto. The clock receives a time reference signal and a date reference signal from descrambler **21A** and synchronizes its operation therewith.

User interface **30** is coupled to access controller **28A** and supplies user input signals thereto. The user input signals are generated as a function of input supplied by a user to the user interface which may include a keyboard or user-operated switches. Typical user input signals include a command to display video signals, a command to record broadcast video signals, an authorization code, a request for a specific video program, and so on.

Modem **31** is coupled to access controller **28A** and to communication link **106** and facilitates the communication of signals through the communication link between broad-

casting station **101** (shown in FIG. **1**) and the access controller. As communication link **106** is preferably a telephone line, modem **31** is preferably a conventional telephone line modem.

Access controller **28A** is further coupled to an access condition memory **29**. It will be appreciated that, as a function of the signals supplied to access controller **28A** by clock **27**, user interface **30**, modem **31**, and access condition memory **29**, the access controller controls the operation of encipherer **22** and decipherer **25**. As will be discussed in greater detail below, depending upon whether applicable conditions have been fulfilled, the access controller enables or disables the operation of encipherer **22** and decipherer **25**. Access controller **28A** stores access-control signals in and retrieves access-control signals from access condition memory **29**. In an alternate embodiment, it is contemplated that the access controller **28A** stores both access-control signals and the encryption keys of encipherer **22** and decipherer **25** in access condition memory **29**.

Access-control signals indicate the conditions, if any, to be placed on the reproduction of the video component of the selected digital video signals. These conditions describe the circumstances under which a user may or may not reproduce the selected video signals. As a function of the access-control signals, the selected video signals recovered by descrambler **21A** are processed prior to recording and processed again following reproduction. Depending on the particular conditions and circumstances, a user can be prevented entirely from accessing the selected digital video signals, given limited access to the signals, or given full access to the signals. Such conditions may include, but are not limited to, one or more of the following: (1) previous receipt of a payment signal from broadcasting station **101**, (2) a numerical limit on the number of times particular video signals may be reproduced or displayed, (3) a temporal limit on the reproduction or display of video signals, and (4) previous receipt of a user authorization code. Preferably, the access-control signals are comprised of simple default values.

Also illustrated in FIG. **2** is storage cassette **104A** which comprises access condition memory **29** and storage medium **40**. Storage cassette **104A** is, as a whole, removably connected to receiving system **102A**. Access condition memory **29** stores access-control signals indicating the conditions, if any, to be placed on the reproduction and/or recording of video signals on storage medium **40**. Preferably, access condition memory **29** is an integrated circuit RAM, integrated into storage cassette **104A** but independent of storage medium **40**, as has been proposed heretofore, and electrically connectable to access controller **28A**. Storage medium **40** stores signals recorded thereon by head **24** and is preferably removably engaged therewith.

Operation of the embodiment of the controlled-access broadcast digital video signal receiving system **102A** shown in FIG. **2** will be described below. An important feature of this embodiment is that access-control signals, corresponding to video signals that are to be recorded on or reproduced from storage medium **40**, are stored in access condition memory **29**. Access controller **28A** controls the operation of encipherer **22** and decipherer **25** as a function of one or more of the access-control signals stored in access condition memory **29** and/or received from modem **31**. In this manner, the encryption and decryption of video signals is controlled to prevent unauthorized reproduction of the video signals.

The configuration of the present invention is compatible with many different sequences of signal transfer between broadcasting station **101** and receiving system **102A**. Examples of useful signal transfer sequences, implemented in different modes of operation of the present invention, will be described in detail below. Through the different modes of operation, video programs are securely transferred between a broadcaster and a consumer for recording, but the consumer's ability to display the programs can be subjected to limitations.

In a first video-on-demand mode, a user enters into user interface **30** a request for a specific video program. User interface **30** transmits this request to access controller **28A**, which, in turn, communicates the user's request through modem **31** and communication link **106** to broadcasting station **101**. The broadcasting station transmits the requested video program to satellite **107** which relays the video program to antenna **103** and supplies the video signals representing this program to tuner **20**. It is expected that several video signals are coupled to tuner **20**, which selects the particular video signals comprising the requested video program and supplies these selected video signals to descrambler **21A**. The descrambler descrambles these broadcast video signals and supplies a descrambled version of the video signals to encipherer **22**. Descrambler **21A** also supplies a time reference signal and a date reference signal, which accompany the video program transmission, to clock **27**.

Additionally, broadcasting station **101** communicates access-control signals through communication link **106** and modem **31** to access controller **28A** for storage in access condition memory **29**. The access-control signals serve to define the conditions or limitations, if any, upon the usage of the requested video program. In general, a user can either purchase or rent a particular video program from a broadcaster. In a prepayment method of purchase, a user pays for a video program and subsequently requests that the broadcaster transmit the program to the user's video receiving system. Broadcasting station **101** transmits the requested program and an access-control signal indicating that the video program can be unconditionally recorded and reproduced (FULL ACCESS). Access controller **28A** stores the FULL ACCESS signal in access condition memory **29** to disable encipherer **22**. Hence, descrambled video signals of the video program are supplied by descrambler **21A** through encipherer **22**, without encryption, to recording/reproducing section **23A**, whereat the descrambled and unencrypted video signals are recorded on storage medium **40**.

In a postpayment method of purchase, wherein a user elects to pay for a video program after it has been received by the user's receiving system, broadcasting station **101** transmits the particular video program to receiving system **102A** along with an access-control signal indicating that the video program cannot be reproduced (NO REPRO). Access controller **28A** stores the NO REPRO signal in access condition memory **29** and enables encipherer **22**, causing it to encrypt, according to an encryption key, descrambled video signals of the video program supplied by descrambler **21A**. Encipherer **22** supplies encrypted video signals to recording/reproducing section **23A**, whereat the encrypted video signals are recorded on storage medium **40**.

It is contemplated that the user subsequently purchases the video program from the broadcaster. Upon payment, broadcasting station **101** transmits an access-control signal to access controller **28A** indicating that the recorded video program can be reproduced (REPRO OK), and this REPRO OK signal replaces the previously stored NO REPRO signal in memory **29**. When the encrypted video signals subsequently are played back from storage medium **40**, they are

supplied to decipherer **25** which is enabled by the stored REPRO OK signal to decrypt the reproduced video signals.

In a second prepayment method of purchase, similar to the postpayment method, the user pays for the selected program prior to its transmission, but broadcasting station **101** first transmits the selected program to receiving system **102A** along with a NO REPRO signal. Access controller **28A** causes encipherer **22** to encrypt the video signals of the video program and the encrypted signals are recorded on storage medium **40** while the NO REPRO signal is stored in access condition memory **29**. Upon completion of the video program transmission, broadcasting station **101** transmits a REPRO OK signal; and access controller **28A** replaces the stored NO REPRO signal with the REPRO OK signal. Thus, the video program is recorded in encrypted form but the user can reproduce and decrypt the program an unlimited number of times. This second prepayment method has the advantage of producing video recordings that can only be reproduced in devices having compatible decryption capabilities.

Alternatively, a user can purchase the right to reproduce a video program a certain number (N) of times. The user thus "rents" the video program for N reproductions. In one mode, the user enters a request into user interface **30** to rent a video program for N reproductions. User interface **30** transmits the request to access controller **28A** which forwards the request through modem **31** and communication link **106** to broadcasting station **101**. Broadcasting station **101** transmits the requested video program along with an access-control signal indicating that the video program can only be reproduced N times (REPRO N TIMES). The access controller receives the REPRO N TIMES signal and stores it in access condition memory **29**. The video program is received by tuner **20** and supplied to descrambler **21A** which descrambles the video program and supplies descrambled video signals to encipherer **22**. The encipherer, which is enabled by the access controller, encrypts the descrambled video signals, and supplies encrypted signals to recording/reproducing section **23A** for recording on storage medium **40**.

In another rental mode, wherein a user desires to rent a particular video program for a certain period of time, an access-control signal designating the period of time during which reproduction of the requested video program is authorized is supplied by the broadcasting system. For example, the user may request to rent a particular video program for a certain number of days (D). Receiving system **102A** transmits this request via communication link **106** to broadcasting station **101**. The broadcasting station calculates the date Y, as a function of D, on which the reproduction right should expire, and transmits the requested video program along with an access-control signal indicating that reproduction is allowed until date Y (REPRO UNTIL DATE Y). The access-control signal is received by receiving system **102A** and stored in access condition memory **29**. The access controller enables the operation of encipherer **22**; and as described above, the requested video program is received, selected by tuner **20**, descrambled, enciphered, and recorded in enciphered form. Subsequently, the encrypted video program is reproduced, deciphered (so long as the reproduction operation is performed prior to date Y) and displayed.

As another example, a user can request to rent a particular video program for a certain number of hours (H). Receiving system **102A** transmits this request via communication link **106** to broadcasting station **101** which calculates the time T, as a function of H, when the reproduction right should expire, and transmits the requested video program along with an access-control signal indicating that reproduction is allowed until time T (REPRO UNTIL TIME T). The received access-control signal is stored in access condition memory **29**; and the operation of encipherer **22** is enabled by access controller **28A**. As described above, the requested video program is received, selected, descrambled, enciphered, and recorded in an enciphered form.

Of course, there are many different methods of expressing the terms of a rental. The preceding expressions are intended merely as examples to assist in explaining the present invention and not as limits thereon. Further examples of useful rental terms include: reproduction of a video program for a certain number of hours or of days, or for a period of time in the future.

Analogous to the prepayment and postpayment methods of purchase, each rental of a video program can be prepaid or postpaid by the user. When the rental is prepaid, broadcasting station **101** transmits the requested program and the access-control signal specifying the terms of the rental to receiving system **102A** which processes the video program (i.e., selectively encrypts the video signals) and stores the access-control signal as described above.

In contrast, when the rental is postpaid, broadcasting station **101** transmits the requested program and a NO REPRO signal to receiving system **102A**, which encrypts and records the video program and stores the NO REPRO signal as described above. Upon proper payment, broadcasting station **101** transmits the access-control signal specifying the terms of the rental to the receiving system which replaces the NO REPRO signal in access condition memory **29** with the newly-transmitted access-control signal.

In a further variation, a certain segment of the video program can be made available for reproduction by a user in a "preview" mode of operation. In this "preview" mode a user can view a selected portion of the requested video program and later decide whether or not to purchase or rent the entire video program. In an illustrative implementation of the preview mode, the access-control signal corresponding to the preview segment is a REPRO OK signal and the access-control signal corresponding to the entire video program is a NO REPRO signal.

In a second video-on-demand mode, a user requests video programming from a broadcaster to be transmitted at a later time, perhaps the following day. The video programming may be, for example, one or more video programs selected by the user or a number of video programs selected by the broadcaster. In the latter case, it is contemplated that the user initially selects a particular type of video programming or selects video programming provided by a particular video program supplier.

The request for "delayed" transmission of the video programming is entered by the user into user interface **30**. User interface **30** transmits this request to access controller **28A** which communicates the user's request through modem **31** and communication link **106** to broadcasting station **101**.

Some period of time later, broadcasting station **101** transmits the requested video programming to satellite **107** which relays the video programming to antenna **103**. Preferably, transmission of the video programming occurs during periods when broadcasters are "off-the-air" or during periods of low viewership of broadcast video signals. Antenna **103** receives the video programming and supplies the video signals to tuner **20** from which the particular video signals comprising the requested video programming are supplied to descrambler **21A** which, in turn, supplies a descrambled version of the video signals to encipherer **22**.

In this mode, broadcasting station **101** also transmits two access-control signals via communication link **106** and

modem 31 to access controller 28A. One access-control signal indicates that the video programming is to be erased on a certain date Y (ERASE ON DATE Y) and the other access-control signal is the NO REPRO signal. Access controller 28A stores the ERASE ON DATE Y signal and the NO REPRO signal in access condition memory 29. Encipherer 22, when enabled, supplies encrypted video signals to recording/reproducing section 23A for recording on storage medium 40.

Subsequently, but prior to date Y, the user selects a video program from the requested video programming stored on storage medium 40 and pays the fee to rent the selected program for a particular rental term. Upon payment, broadcasting station 101 transmits the access-control signal indicating the appropriate rental condition to access controller 28A which replaces the previously stored NO REPRO signal in memory 29. Hence, the ERASE ON DATE Y signal remains stored in access condition memory 29.

Illustrative video signal reproduction modes of operation of receiving system 102A now will be described. The process is initiated when a user enters a command into user interface 30 to reproduce a prestored video program recorded on storage cassette 104A. The user interface transmits the command to access controller 28A which retrieves the access-control signal stored in access condition memory 29 of the storage cassette. The operation of decipherer 25 is controlled as a function of the particular access-control signal(s) that is retrieved.

If, for example, the retrieved signal is a FULL ACCESS signal, then access controller 28A disables decipherer 25. Recording/reproducing section 23A recovers video signals from storage medium 40 and supplies the reproduced video signals to decipherer 25, which passes the video signals to decoder 26. As described above, the reproduced video signals are unencrypted; and decoder 26 decodes the video signals and supplies uncoded video signals to video display 105.

If the NO REPRO signal is retrieved from access condition memory 29, access controller 28A disables the operation of decipherer 25. However, unlike the FULL ACCESS signal case, the video signals stored on storage medium 40 are encrypted. Hence, recording/reproducing section 23A reproduces encrypted video signals which are supplied to decipherer 25 to be passed directly to decoder 26 without decryption. The decoder decodes the encrypted video signals to produce uncoded but encrypted video signals which are supplied to video display 105. As a result, the video display either cannot display the video signals at all or can only display a distorted version of the original video program.

As a further alternative, access controller 28A may retrieve a REPRO OK signal from access condition memory 29 to enable the operation of decipherer 25. Recording/reproducing section 23A reproduces the encrypted video signals stored on storage medium 40 and supplies the encrypted signals to enabled decipherer 25 which decrypts the video signals and supplies unencrypted video signals to decoder 26. The decoder decodes the video signals and supplies the resulting uncoded and decrypted video signals to video display 105 for display. Because the video signals are uncoded and decrypted, video display 105 displays the reproduced video program without distortion.

As yet another alternative, when access controller 28A retrieves a REPRO N TIMES signal from access condition memory 29, the access controller 28A determines whether the number N is greater than a predetermined threshold value (e.g. zero). If the number N is not greater than the threshold value, then access controller 28A disables operation of decipherer 25 and reproduction of the stored video signal proceeds as in the NO REPRO signal case. On the other hand, if the number N is greater than the threshold value, then access controller 28A enables decipherer 25 and reproduction of the stored video signal proceeds as in the REPRO OK signal case.

After the video signal is reproduced from storage medium 40, if the number N is greater than the threshold value, access controller 28A subtracts one from the value of N to produce a new value N and writes a new REPRO N TIMES signal, utilizing the new value N, into access condition memory 29 whereat the previously stored REPRO N TIMES signal is replaced by the new REPRO N TIMES signal. According to this procedure, the particular video signals stored in storage medium 40 to which the REPRO N TIMES signal corresponds are only reproduced the number of times represented by the number N. The value N stored in access condition memory 29 thus reflects the remaining number of permitted reproductions of the particular video signals. Since the access condition memory is provided in the same storage cassette 104A as storage medium 40, and the video signals are encrypted on the storage medium, the video signals can only be reproduced for display N times even if the cassette is loaded into another receiving system, at least until a new access-control signal is stored.

When, as described above, a video program is rented for only a certain period of time, access controller 28A retrieves the corresponding access-control signal from access condition memory 29 and also receives a clock signal and a date signal from clock 27. The clock signal and the date signal are compared to the retrieved access-control signal, and if the particular condition expressed in the access-control signal is satisfied such that reproduction is allowed, then decipherer 25 is enabled and reproduction of the stored video signals proceeds as in the REPRO OK case. However, if the condition expressed by the access-control signal is not satisfied such that reproduction of the video signals is not allowed, then the decipherer is disabled and reproduction of the stored video signals proceeds as described with respect to the NO REPRO signal.

For example, when access controller 28A retrieves a REPRO UNTIL DATE Y signal from access condition memory 29, it compares the date signal from clock 27 to the date Y. If the date from clock 27 is prior to date Y, then the access controller enables the operation of decipherer 25 to decrypt the reproduced, encrypted video signals. In a similar fashion, when the access controller retrieves a REPRO UNTIL TIME T signal from the access condition memory, it compares the time signal supplied by clock 27 with the time T. If the time indicated by the time signal is prior to time T, then reproduction of the stored video signals proceeds as described with respect to the REPRO OK signal.

In an analogous manner, when access controller 28A retrieves an ERASE ON DATE Y signal from access condition memory 29, it compares the date signal from clock 27 to the date Y. If the date indicated by clock 27 is the same as or past date Y, then the access controller controls recording/reproducing section 23A to erase the video signals stored on storage medium 40. A suitable control channel, or link, may be provided between access controller 28A and recording/reproducing section 23A.

An alternate embodiment of receiving system 102A additionally includes a connection between descrambler 21A and access controller 28A. Here, scrambled access-control sig-

nals that are transmitted by broadcasting station **101** along with the video signals are supplied to and descrambled by descrambler **21A** from which they are coupled to the access controller. In this alternate embodiment, video signals are recorded and reproduced as described above, and encipherer **22** and decipherer **25** are selectively enabled and disabled in response to the received access-control signals in the same manner as has been discussed.

As will be appreciated by one of ordinary skill in the art, each of the abovedescribed modes of signal reproduction wherein the user has prepaid for the video programming can be achieved substantially simultaneously with the recording of the broadcast video signals. In such a mode of operation, recording/reproducing section **23A** functions both to record the processed broadcast video signals and to supply the video signals to decipherer **25**. Decipherer **25**, controlled by access controller **28A**, decrypts the video signals as a function of the access-control signal to be stored in access condition memory **29** and decoder **26** decodes the resulting video signals for immediate display on video display **105**.

Another embodiment of the controlled-access broadcast digital video signal receiving system **102B** according to the present invention is illustrated in FIG. **3**. Receiving system **102B** differs from aforedescribed receiving system **102A** in that receiving system **102B** stores access-control signals and video signals in the same storage medium **40** of storage cassette **104B**.

Recording/reproducing section **23B**, through head **24**, records on storage medium **40** in storage cassette **104B** video signals supplied by encipherer **22** and access-control signals supplied by access controller **28B**; and also reads previously recorded video signals and previously recorded access-control signals from the storage medium. The reproduced video signals are supplied to decipherer **25** and the reproduced access-control signals are supplied from the recording/reproducing section to access controller **28B**. As before, recording/reproducing section **23B** is a digital video tape recording/reproducing device (VTR) and storage medium **40** is a video tape; although the storage medium may be a magnetic disc, an optical disc, a magneto-optic disc, a solid-state device, or other recordable medium. It is also preferred that the access-control signals be stored in one or more sub-code regions of the storage medium.

When enabled by access controller **28B**, decipherer **25** decrypts, according to an encryption key, encrypted signals reproduced by recording/reproducing section **23B**. It is contemplated that the encryption key is prestored in the decipherer or is supplied thereto by access controller **28B**, or is included in the video signals or the access-control signals supplied by broadcasting station **101**, or is stored in and read from storage medium **40**. When disabled, decipherer **25** passes video signals from recording/reproducing section **23B** directly to decoder **26** without decrypting such signals.

As a function of the signals supplied to access controller **28B** by clock **27**, user interface **30**, modem **31**, and recording/reproducing section **23B**, the access controller controls the operation of encipherer **22** and decipherer **25** as has been described previously. Specifically, depending upon whether applicable conditions have been fulfilled, the access controller enables or disables the operation of encipherer **22** and decipherer **25**.

Each signal transfer sequence, including variations thereon, described above with respect to receiving system **102A** is also implemented in similar modes of operation of receiving system **102B**. It will be appreciated, then, that the modes of operation of receiving system **102B** are substantially identical to the modes of operation of receiving system **102A** with the following illustrative exceptions. Access controller **28B** functions in the same manner as access controller **28A**, except that access-control signals are stored, through recording/reproducing section **23B**, in storage medium **40**, instead of in a separate access condition memory. Recording/reproducing section **23B** functions in the same manner as section **23A** except that section **23B** additionally records access-control signals on and reproduces access-control signals from storage medium **40**. The reproduced access-control signals are supplied from recording/reproducing section **23B** to access controller **28B**.

Similar to the alternate embodiment discussed in conjunction with FIG. **2**, an alternate embodiment of receiving system **102B** additionally includes a connection between descrambler **21A** and access controller **28B** so that scrambled access-control signals that are transmitted by broadcasting station **101** along with the video signals are descrambled and supplied to the access controller. Of course, access controller **28B** uses these access-control signals in the same manner as discussed above.

A further embodiment of the controlled-access broadcast digital video signal receiving system **102C** according to the present invention is illustrated in FIG. **4**. Receiving system **102C**, is adapted for receiving, descrambling, decoding, recording, and reproducing digital video signals and is similar to the aforedescribed receiving system **102A** of FIG. **2**. As in receiving system **102A**, receiving system **102C** stores access-control signals in access condition memory **29** of storage cassette **104A**, while the video signals are stored on storage medium **40** of the storage cassette.

FIG. **4** differs from FIG. **2** in that descrambler **21C** of receiving system **102C** is coupled to access controller **28C**, recording/reproducing section **23A**, and decoder **26**; and encipherer **22** and decipherer **25** are not provided as separate circuits. When enabled by access controller **28C**, descrambler **21C** descrambles video signals supplied by tuner **20** and supplies an unscrambled version of the digital video signals to recording/reproducing section **23A**. Also, when enabled by the access controller, descrambler **21C** descrambles video signals reproduced by recording/reproducing section **23A** and supplies an unscrambled version of the digital video signals to decoder **26**. When disabled by access controller **28C**, descrambler **21C** passes scrambled video signals from tuner **20** directly, without encryption, to section **23A** and also passes video signals reproduced by the recording/reproducing section directly, without decryption, to decoder **26**. Scrambled video signals can be recorded but they cannot be displayed in scrambled form.

It will be appreciated that access controller **28C** functions in the same general manner as access controller **28A**, except that descrambler **21C** is controlled in accordance with the access-control signals rather than encipherer **22** and decipherer **25**.

At those aforedescribed operational steps where access controller **28A** enables encipherer **22**, access controller **28C** disables descrambler **21C** to pass scrambled signals to the recording/reproducing section; and where access controller **28A** disables encipherer **22**, access controller **28C** enables descrambler **21C** to supply descrambled signals to the recording/reproducing section. However, in the operational steps where access controller **28A** enables decipherer **25**, access controller **28C** similarly enables descrambler **21C** to descramble the signals reproduced by the recording/reproducing section. Where access controller **28A** disables decipherer **25**, access controller **28C** similarly disables

descrambler 21C to pass to decoder 26 signals reproduced by the recording/reproducing section.

In an alternate embodiment of receiving system 102C, access-control signals, transmitted by broadcasting station 101 along with video signals, are received through antenna 103 and supplied by tuner 20 to descrambler 21C for descrambling and for coupling to access controller 28C.

A still further embodiment of the controlled-access broadcast digital video signal receiving system 102D according to the present invention is illustrated in FIG. 5. Receiving system 102D is seen to be a combination of portions of receiving system 102C and receiving system 102B (FIG. 3). Similar to receiving system 102B, receiving system 102D stores access-control signals and video signals in the same storage medium 40 of storage cassette 104B. Recording/reproducing section 23B supplies the reproduced video signals to descrambler 21C and supplies the reproduced access-control signals to access controller 28D.

It will be appreciated that the modes of operation of receiving system 102D are substantially similar to the modes of operation of receiving system 102C with the following illustrative exceptions. Access controller 28D functions in the same manner as access controller 28C, except that access-control signals are stored in storage medium 40 instead of in a separate access condition memory. Recording/reproducing section 23B functions in the same manner as section 23A except that section 23B additionally records access-control signals on and reproduces access-control signals from storage medium 40. The reproduced access-control signals are supplied from recording/reproducing section 23B to access controller 28D.

Similar to the alternate embodiment discussed in conjunction with FIG. 4, access-control signals, transmitted by broadcasting station 101 along with video signals, are received through antenna 103 and supplied by tuner 20 to descrambler 21C for descrambling; and the descrambled access-control signals are supplied to access controller 28D. It is seen that access controller 28D receives access-control signals from recording/reproducing section 23B and either from modem 31 or from descrambler 21C, or from both.

FIG. 6 is a flow diagram of a preferred mode of operation of receiving system 102A of FIG. 2, as controlled by access controller 28A, wherein a user orders from a broadcaster a limited or an unlimited right (as may be desired) to reproduce a video program. The user initiates the process by entering a request for a particular video program at user interface 30. The process begins at step S60, where access controller 28A causes modem 31 to connect to broadcasting station 101.

Access controller 28A transmits identification information through modem 31 and communication link 106 to broadcasting station 101 which checks the identification information against a subscription list and determines whether the user has subscribed to the broadcasting station's service, as represented by inquiry S61. If the user is not subscribed, the broadcasting station terminates the connection with receiving system 102A in step S62.

If the user is subscribed, inquiry S61 is answered in the affirmative and operation continues to inquiry S63, which polls the user to determine whether or not the video program is to be purchased. If the user enters an affirmative response into user interface 30, operation proceeds to inquiry S64. Otherwise, operation proceeds to inquiry S65.

At inquiry S64, the broadcasting station 101 determines whether the user has prepaid for the video program and if not, the user is further queried to determine if payment will be made at that time. If the price of the video program has been previously paid or is immediately paid, then processing proceeds with step S66. Otherwise, processing proceeds with step S67.

In step S66, broadcasting station 101 transmits the video program via satellite to antenna 103 and transmits the FULL ACCESS signal via communication link 106 and modem 31 to access controller 28A. Access controller 28A disables encipherer 22, allowing the video program to be recorded in an unencrypted form on storage medium 40, and the access controller also stores the FULL ACCESS signal in access condition memory 29.

In step S67, broadcasting station 101 transmits the video program via satellite to antenna 103 and transmits the NO REPRO signal via communication link 106 and modem 31 to access controller 28A. The access controller enables encipherer 22, causing the video program to be encrypted and then recorded in encrypted form on storage medium 40, and the NO REPRO signal is stored in access condition memory 29.

If the video program is not to be purchased, resulting in a negative answer to inquiry S63, the operation proceeds to inquiry S65 whereat the user is polled to determine whether the video program is to be rented for a number (N) of viewings. If the user enters an affirmative response into user interface 30, the number N is entered, and operation proceeds to inquiry S69. Otherwise, operation proceeds to inquiry S68.

At inquiry S69, the broadcasting station 101 determines whether the user has prepaid for the N viewings of the video program and if not, the user is further queried to determine if payment will be made at that time. If the fee for N viewings of the video program has been previously paid or is immediately paid, processing proceeds with step S71. Otherwise, processing proceeds with step S72.

In step S71, broadcasting station 101 transmits the video program via satellite to antenna 103 and transmits the REPRO N TIMES signal via communication link 106 and modem 31 to access controller 28A. The access controller 28A enables encipherer 22, causing the video program to be encrypted and then recorded on storage medium 40; and the REPRO N TIMES signal is stored in access condition memory 29.

In step S72, broadcasting station 101 transmits the video program via satellite to antenna 103 and transmits the NO REPRO signal via communication link 106 and modem 31 to access controller 28A. The access controller enables encipherer 22, causing the video program to be encrypted and then recorded on storage medium 40; and the NO REPRO signal is stored in access condition memory 29.

If the video program is not to be rented for N viewings, inquiry S65 is answered in the negative and the operation proceeds to inquiry S68 whereat the user is polled to determine whether a video program is to be rented for viewing until a date Y. If the user enters an affirmative response into user interface 30, the date Y is entered, and operation proceeds to inquiry S70. Otherwise, operation returns step S62, described above.

At inquiry S70, the broadcasting station 101 determines whether the user has prepaid for the rental of the video program until date Y and if not, the user is further queried to determine if payment will be made at that time. If the fee for the rental period has been previously paid or is immediately paid, then processing proceeds with step S73. Otherwise, processing proceeds with step S72, described above.

In step S73, broadcasting station 101 transmits the video program via satellite to antenna 103 and transmits the REPRO UNTIL DATE Y signal via communication link 106 and modem 31 to access controller 28A. The access controller enables encipherer 22, causing the video program to be encrypted and then recorded in encrypted form on storage medium 40. Access controller 28A also stores the REPRO UNTIL DATE Y signal in access condition memory 29.

FIG. 7 is a flow diagram of a preferred mode of operation of receiving system 102A of FIG. 2 wherein a user seeks to reproduce a selected previously recorded video program. The user initiates the process by supplying a request to reproduce a prerecorded video program at user interface 30 and the process begins at step S80, where access controller 28A retrieves from access condition memory 29 the access-control signal corresponding to the selected video program. The process proceeds to inquiry S81 whereat the access controller determines if the access-control signal is the NO REPRO signal. If so, processing proceeds with step S86; otherwise, processing proceeds to inquiry S82.

In step S86, access controller 28A causes modem 31 to connect to broadcasting station 101 and transmits identification information and program information to the broadcasting station. Processing then proceeds to inquiry S88 which queries the user to determine if payment of the full purchase price for the video program will be made at that time. If the purchase price of the video program is paid, then processing proceeds with step S93. Otherwise, processing proceeds to inquiry S89.

In step S93, broadcasting station 101 transmits the REPRO OK signal via communication link 106 and modem 31 to access controller 28A which stores the REPRO OK signal in access condition memory 29, replacing the NO REPRO signal, and processing proceeds to step S97. In step S97, the access controller enables decipherer 25; and the selected video program which is reproduced from storage medium 40 is decrypted by decipherer 25, decoded by decoder 26, and supplied for display to video display 105.

If the retrieved access-control signal is not the NO REPRO signal, as represented by a negative answer to inquiry S81, inquiry S82 determines whether the access-control signal is the REPRO N TIMES signal. If so, processing proceeds with step S94. Otherwise, processing proceeds to inquiry S83. In step S94, access controller 28A decrements N by one, debiting the single reproduction which will immediately follow. Further, the REPRO N−1 TIMES signal is stored in access condition memory 29, replacing the access-control signal previously stored there, and processing proceeds to step S97 to reproduce and decrypt the video signal, described above.

If the retrieved access-control signal is not the REPRO N TIMES signal, inquiry S83 is made to determine if the access-control signal is the REPRO UNTIL DATE Y signal. If so, processing proceeds to inquiry S87. Otherwise, processing proceeds to inquiry S84. Inquiry S87 compares the date signal supplied by clock 27, indicating the current date, with date Y. If the current date is prior to date Y, then processing proceeds to step S97, described above. Otherwise, processing proceeds to step S90, whereat access controller 28A determines that the applicable condition has not been satisfied and therefore no video signal reproduction is authorized. The access controller thereafter terminates the connection with broadcasting station 101.

If the retrieved access-control signal is neither the NO REPRO nor the REPRO N TIMES nor the REPRO UNTIL DATE Y signal, inquiry S84 determines if the access-control signal is the REPRO OK signal. If it is, processing proceeds with step S97, described above. Otherwise, processing advances to inquiry S85 whereat access controller 28A determines if the access-control signal is the FULL ACCESS signal. If so, processing proceeds with step S96. Otherwise, processing proceeds with step S92.

In step S92, access controller 28A determines that it has failed to recognize the particular access-control signal stored in condition access memory 29, if any. Lacking a recognizable access-control signal, no video signal reproduction is authorized. Access controller 28A terminates the connection with broadcasting station 101. It should be appreciated that step S92 can be replaced with additional access-control signal definitions to provide further processing and access-control signal permutations.

In step S96, access controller 28A disables decipherer 25, and recording/reproducing section 23A reproduces the selected video program from storage medium 40. The reproduced video program passes through decipherer 25 for decoding by decoder 26, and is supplied to video display 105 for display.

If the retrieved access-control signal is the NO REPRO signal and payment of the full purchase price is not made, inquiry S88 is answered in the negative and the process advances to inquiry S89, which queries the user to determine if the fee for N viewings of the video program will be paid. If the fee for N viewings of the video program is paid, then broadcasting station 101 transmits the REPRO N TIMES signal via communication link 106 and modem 31 to access controller 28A, and processing proceeds with step S94, described above. Otherwise, processing proceeds to inquiry S91 which queries the user to determine if the fee for rental of the video program until date Y will be paid. If the fee for such a rental is paid, then processing proceeds with step S95. Otherwise, processing proceeds with step S90, described above.

In step S95, broadcasting station 101 transmits the REPRO UNTIL DATE Y signal via communication link 106 and modem 31 to access controller 28A which stores the REPRO UNTIL DATE Y signal in access condition memory 29, replacing the NO REPRO signal, and processing proceeds to step S97, described above.

Those of ordinary skill in the art will readily appreciate the modifications to be made to the flow diagrams of FIGS. 6 and 7 to control the operation of the controlled-access broadcast video signal recording systems shown in FIGS. 3, 4 and 5. Hence, in the interest of brevity, further description of such modified flow diagrams is not made.

Although illustrative embodiments of the present invention and modifications thereof have been described in detail herein, it is to be understood that this invention is not limited to these precise embodiments and modifications, and that other modifications and variations may be effected therein by one skilled in the art without departing from the scope and spirit of the invention as defined by the appended claims. For example, it is contemplated that a broadcast video program can be processed by an apparatus according to the present invention for display to a user without a preceding or simultaneous recording of the video program.

What is claimed is:

1. Apparatus for receiving, recording, and reproducing data signals, comprising:

receiving means for receiving said data signals and an access-control signal generated by a remote provider which grants users rights to reproduce said data signals;

processing means, coupled to said receiving means, for processing said data signals to produce processed data signals;

control means for controlling said processing means in response to said access-control signal;

storage means for storing said processed data signals and for storing said access-control signal;

means for reproducing said stored processed data signals to produce reproduced data signals and for retrieving said stored access-control signal; and

reprocessing means coupled to said control means for reprocessing said reproduced data signals in response to said retrieved access-control signal.

2. Apparatus according to claim 1 wherein said data signals are digital video data signals.

3. Apparatus according to claim 1 wherein said receiving means receives said data signals and said access-control signal from a broadcasting station.

4. Apparatus according to claim 1 wherein said receiving means further comprises a tuner for receiving broadcast signals.

5. Apparatus according to claim 4 wherein said receiving means further comprises a modem for receiving said access-control signal.

6. Apparatus according to claim 1 wherein said receiving means further comprises a modem for receiving said access-control signal.

7. Apparatus according to claim 1 wherein said receiving means further comprises a user interface for receiving said access-control signal from a user.

8. Apparatus according to claim 1 wherein said processing means comprises a descrambler.

9. Apparatus according to claim 1 wherein said processing means comprises a descrambler and an encipherer and wherein said reprocessing means comprises a decipherer.

10. Apparatus according to claim 1 wherein said processing means comprises an encipherer and wherein said reprocessing means comprises a decipherer.

11. Apparatus according to claim 1 wherein said processed data signals are stored on a record medium and said access-control signal is stored in a separate storage medium.

12. Apparatus according to claim 11 wherein said record medium is a video tape.

13. Apparatus according to claim 11 wherein said separate storage medium is an integrated circuit memory.

14. Apparatus according to claim 1 wherein said processed data signals and said access-control signal both are stored on a common record medium.

15. Apparatus according to claim 1 further comprising a clock, coupled to said receiving means and to said control means, for supplying a clock signal to said control means;

wherein said data signals include a clock reference signal; and

wherein said clock signal is synchronized with said clock reference signal.

16. Apparatus according to claim 1 further comprising a decoder, coupled to said reprocessing means, for decoding said reprocessed data signals.

17. Apparatus for receiving and recording data signals, comprising:

receiving means for receiving said data signals and an access-control signal generated by a remote provider which grants users rights to reproduce said data signals;

processing means, coupled to said receiving means, for processing said data signals to produce processed data signals;

control means for controlling said processing means in response to said access-control signal; and

storage means for storing said processed data signals and said access-control signal.

18. Apparatus according to claim 17 wherein said processing means comprises a descrambler.

19. Apparatus according to claim 18 wherein said processing means further comprises an encipherer.

20. Apparatus according to claim 17 wherein said processing means comprises an encipherer.

21. Apparatus according to claim 17 wherein said storage means comprises a storage cassette.

22. Apparatus according to claim 21 wherein said storage cassette contains a record medium on which said processed data signals are recorded and an integrated circuit memory in which said access-control signal is stored.

23. Apparatus for reproducing processed data signals, comprising:

means for reproducing stored processed data signals to produce reproduced data signals and for retrieving a stored access-control signal generated by a remote provider which grants users rights to reproduce said data signals;

reprocessing means for reprocessing said reproduced data signals to produce reprocessed data signals; and

control means for controlling said reprocessing means in response to said retrieved access-control signal.

24. Apparatus according to claim 23 wherein said reprocessing means comprises a descrambler.

25. Apparatus according to claim 23 wherein said reprocessing means comprises a decipherer.

26. Apparatus according to claim 23 wherein said processed data signals and said access-control signals are stored in a storage cassette.

27. A method for transferring from a broadcaster to a receiver a limited reproduction right in data, comprising the steps of:

transmitting from said broadcaster to said receiver an access-control signal generated by a remote provider and said data, said access-control signal indicating said limited reproduction right;

receiving, at said receiver, said access-control signal and said data;

processing, at said receiver, said data in response to said access-control signal to produce processed data;

storing, at said receiver, said processed data and said access-control signal;

retrieving, at said receiver, said stored access-control signal;

reproducing, at said receiver, said stored processed data to produce reproduced data; and

reprocessing, at said receiver, said reproduced data in response to said retrieved access-control signal.

28. The method, according to claim 27, wherein said limited reproduction right is the right to reproduce said data N times.

29. The method, according to claim 27, wherein said limited reproduction right is the right to reproduce said data until date Y.

30. The method, according to claim 27, wherein said limited reproduction right is the right to reproduce said data until time T.

31. The method, according to claim 27, wherein said data is transmitted in scrambled form and said step of processing said data comprises descrambling said data.

32. The method, according to claim 31, wherein said step of processing said data further comprises enciphering said data; and

wherein said step of reprocessing said reproduced data comprises deciphering said reproduced data.

33. The method, according to claim 27, wherein said step of processing said data comprises enciphering said data; and

wherein said step of reprocessing said reproduced data comprises deciphering said reproduced data.

34. The method, according to claim 27, wherein said data is transmitted and stored in scrambled form, and said step of reprocessing said reproduced data comprises descrambling said reproduced data.

35. The method, according to claim 27, wherein said processed data and said access-control signal are stored on a storage cassette.

36. A method for transferring from a broadcaster to a receiver a limited reproduction right in prerecorded data, comprising the steps of:

transmitting from said broadcaster to said receiver an access-control signal generated by a remote provider, said access-control signal indicating said limited reproduction right;

receiving, at said receiver, said access-control signal;

reproducing, at said receiver, said prerecorded data; and

processing, at said receiver, said reproduced data in response to said access-control signal.

37. The method, according to claim 36, wherein said step of processing said reproduced data comprises deciphering said reproduced data.

38. The method, according to claim 36, wherein said step of processing said reproduced data comprises descrambling said reproduced data.

39. A method for reproducing prerecorded data comprising the steps of:

reproducing an access-control signal generated by a remote provider which grants users rights to reproduce said data signals from a first storage medium;

reproducing processed data from a second storage medium in response to said access-control signal to produce reproduced data; and

reprocessing said reproduced data in response to said access-control signal.

40. A method for erasing prerecorded data stored on a record medium in response to an access-control signal stored in a separate memory, comprising the steps of:

retrieving said access-control signal from said separate memory;

determining that said access-control signal is an ERASE signal; and

erasing data stored on said record medium in response to said ERASE signal.

* * * * *

US006430582B1

(12) **United States Patent**
Duncombe

(10) **Patent No.: US 6,430,582 B1**
(45) **Date of Patent: Aug. 6, 2002**

(54) **GOAL SEEKING ENGINE AND METHOD FOR GENERATING CUSTOM MEDIA PRESENTATIONS**

(75) Inventor: **Jefferson D. Duncombe**, Lake Forest, CA (US)

(73) Assignee: **D4 Media, Inc.**, Costa Mesa, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/570,326**

(22) Filed: **May 12, 2000**

Related U.S. Application Data

(63) Continuation-in-part of application No. 09/562,244, filed on Apr. 28, 2000.

(51) **Int. Cl.**[7] **G06F 15/00**

(52) **U.S. Cl.** **707/500.1**; 707/501.1; 345/723

(58) **Field of Search** 707/500, 500.1, 707/501.1; 345/302, 328, 723

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Primary Examiner—Stephen S. Hong
Assistant Examiner—Cong-Lac Huynh
(74) *Attorney, Agent, or Firm*—Eric Karich

(57) **ABSTRACT**

A method of formatting at least one media file allows a user to build a custom media presentation according to parameters specified by the user. According to the method, a plurality of media clips are first defined from the at least one media file. At least two media selection parameters are then defined, each of the at least two media selection parameters having at least one of a plurality of media descriptions. Each of the plurality of media clips is then associated with at least one of the plurality of media descriptions. Once the at least one media file has been properly formatted, desired media parameters are received from the user. The method then teaches selecting a plurality of suitable media clips that are associated with the desired media descriptions, and playing the plurality of suitable media clips.

1 Claim, 8 Drawing Sheets

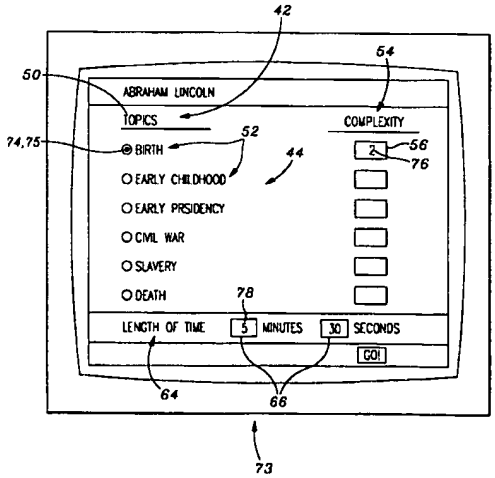

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Fig. 1

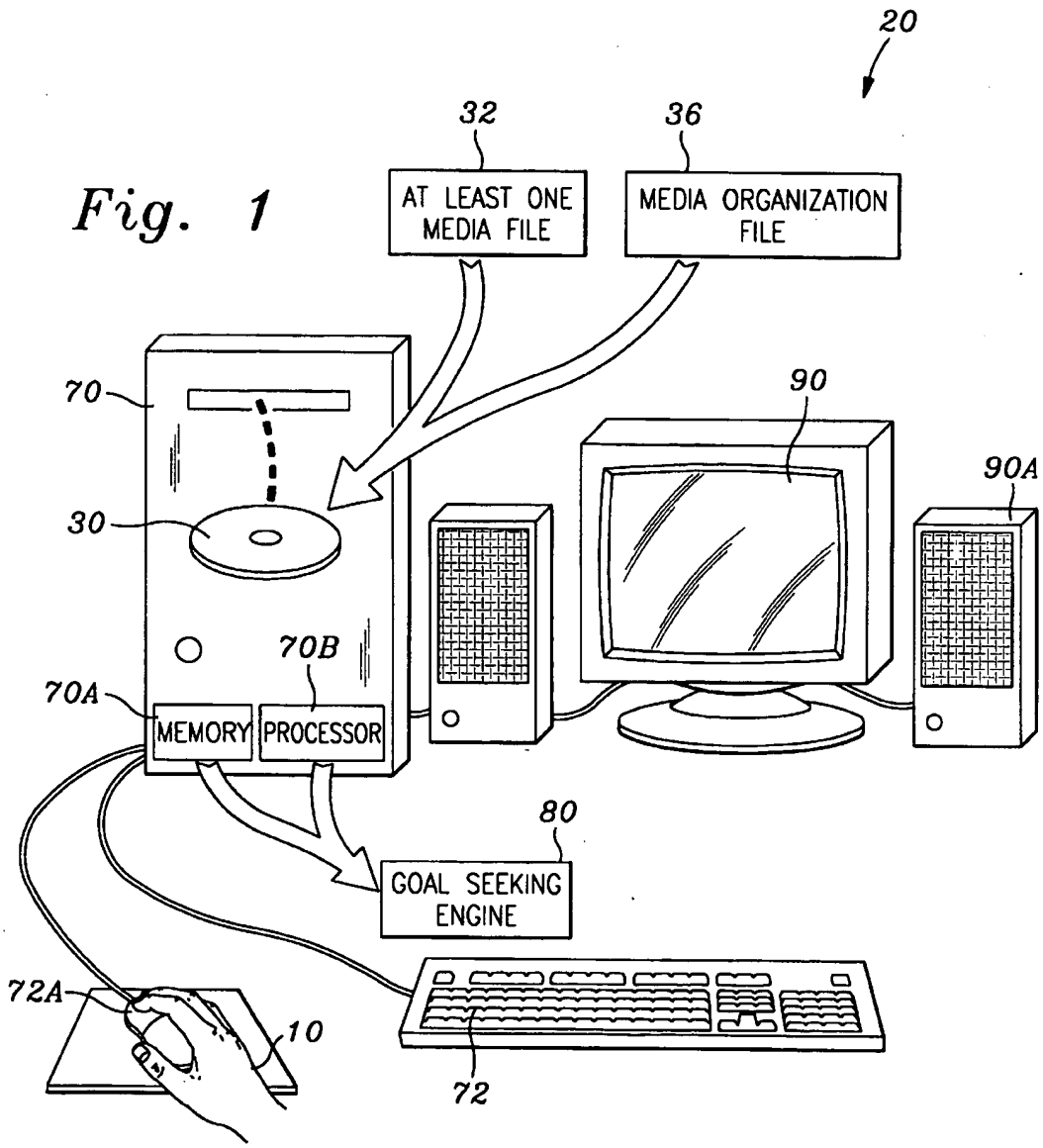

20
32
AT LEAST ONE MEDIA FILE
36
MEDIA ORGANIZATION FILE
70
30
90
90A
70B
70A
MEMORY
PROCESSOR
80
GOAL SEEKING ENGINE
72A
10
72

Fig. 2

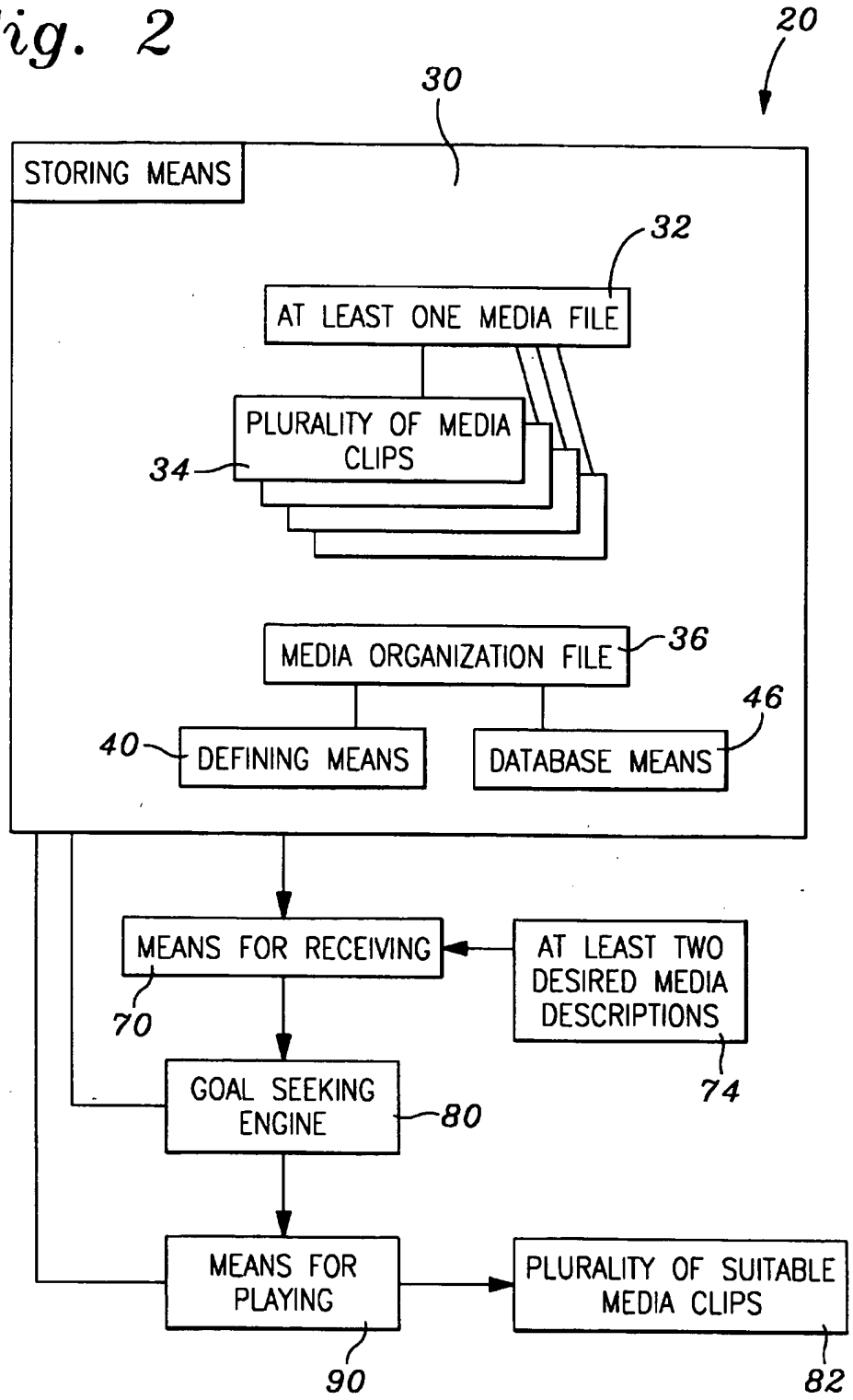
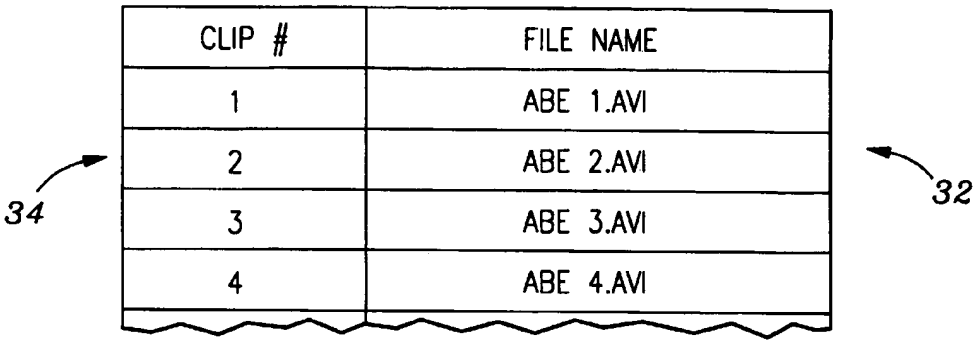
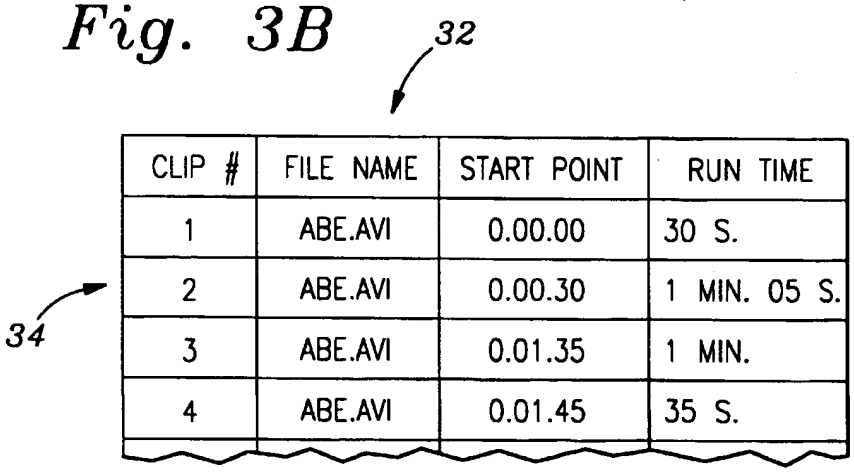

20
30
STORING MEANS
32
AT LEAST ONE MEDIA FILE
PLURALITY OF MEDIA CLIPS
34
MEDIA ORGANIZATION FILE
36
46
40
DEFINING MEANS
DATABASE MEANS
MEANS FOR RECEIVING
70
AT LEAST TWO DESIRED MEDIA DESCRIPTIONS
74
GOAL SEEKING ENGINE
80
MEANS FOR PLAYING
90
PLURALITY OF SUITABLE MEDIA CLIPS
82

Fig. 3A



CLIP #	FILE NAME
1	ABE 1.AVI
2	ABE 2.AVI
3	ABE 3.AVI
4	ABE 4.AVI

Fig. 3B



CLIP #	FILE NAME	START POINT	RUN TIME
1	ABE.AVI	0.00.00	30 S.
2	ABE.AVI	0.00.30	1 MIN. 05 S.
3	ABE.AVI	0.01.35	1 MIN.
4	ABE.AVI	0.01.45	35 S.

Fig. 4

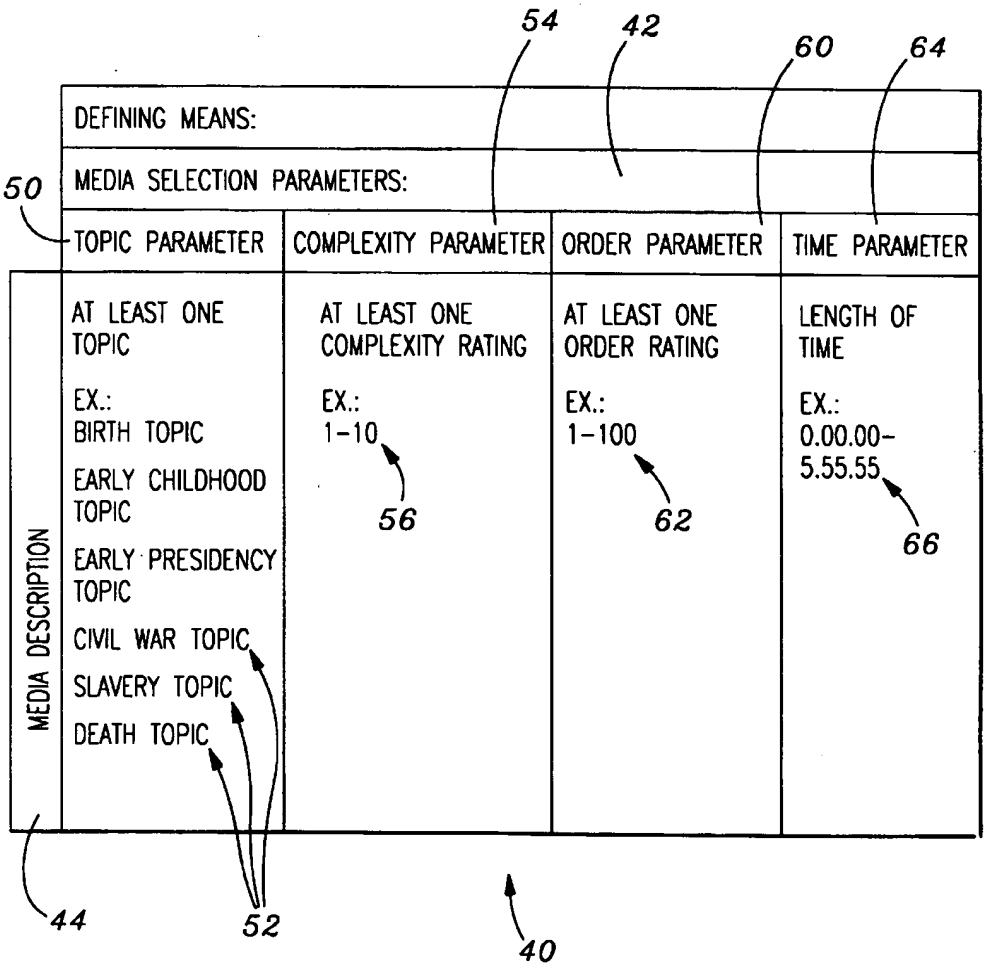

54
42
60
64
DEFINING MEANS:
MEDIA SELECTION PARAMETERS:
50
TOPIC PARAMETER
COMPLEXITY PARAMETER
ORDER PARAMETER
TIME PARAMETER
MEDIA DESCRIPTION
AT LEAST ONE TOPIC
EX.:
BIRTH TOPIC
EARLY CHILDHOOD TOPIC
EARLY PRESIDENCY TOPIC
CIVIL WAR TOPIC
SLAVERY TOPIC
DEATH TOPIC
AT LEAST ONE COMPLEXITY RATING
EX.:
1-10
56
AT LEAST ONE ORDER RATING
EX.:
1-100
62
LENGTH OF TIME
EX.:
0.00.00-
5.55.55
66
44
52
40

Fig. 5

DATABASE MEANS:				
CLIP #	TOPIC	COMPLEXITY	ORDER	TIME (MIN.)
1	BIRTH	1	1	10
2	BIRTH	1	1	5
3	DEATH	1	89	2
4	DEATH	8	92	2
N	–	–	–	–

46

Fig. 6

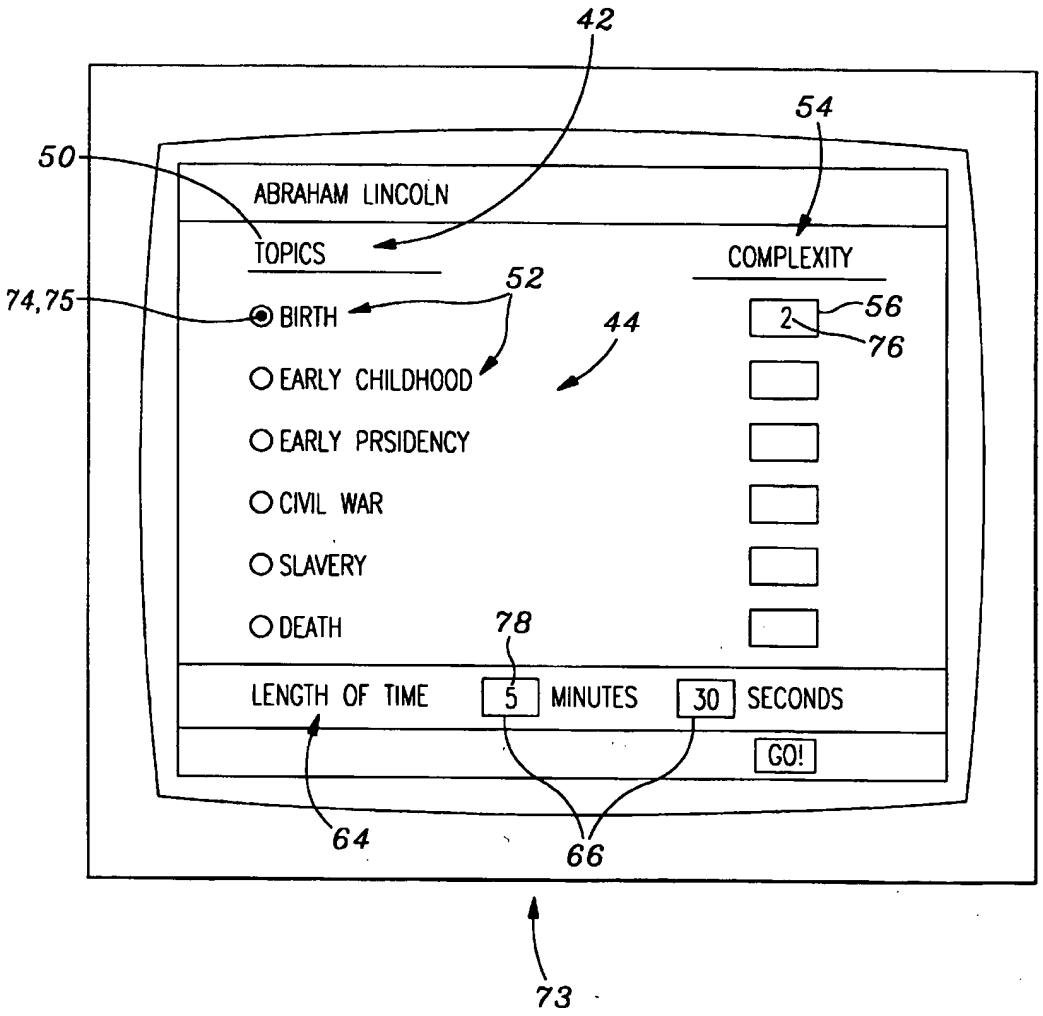

42
54
50
ABRAHAM LINCOLN
TOPICS
COMPLEXITY
74,75
52
BIRTH
2
56
76
44
EARLY CHILDHOOD
EARLY PRSIDENCY
CIVIL WAR
SLAVERY
DEATH
78
LENGTH OF TIME
5
MINUTES
30
SECONDS
GO!
64
66
73

Fig. 7

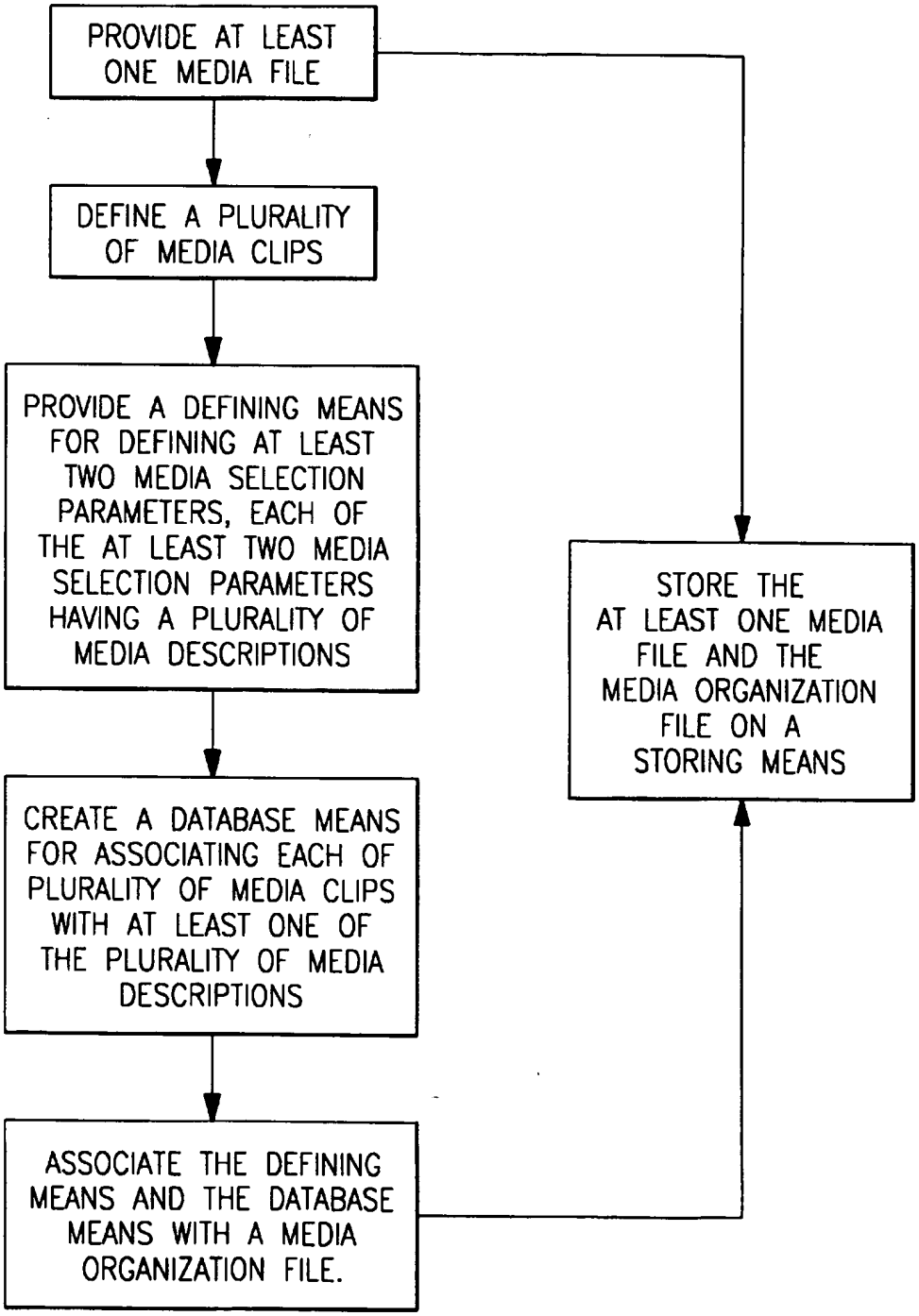
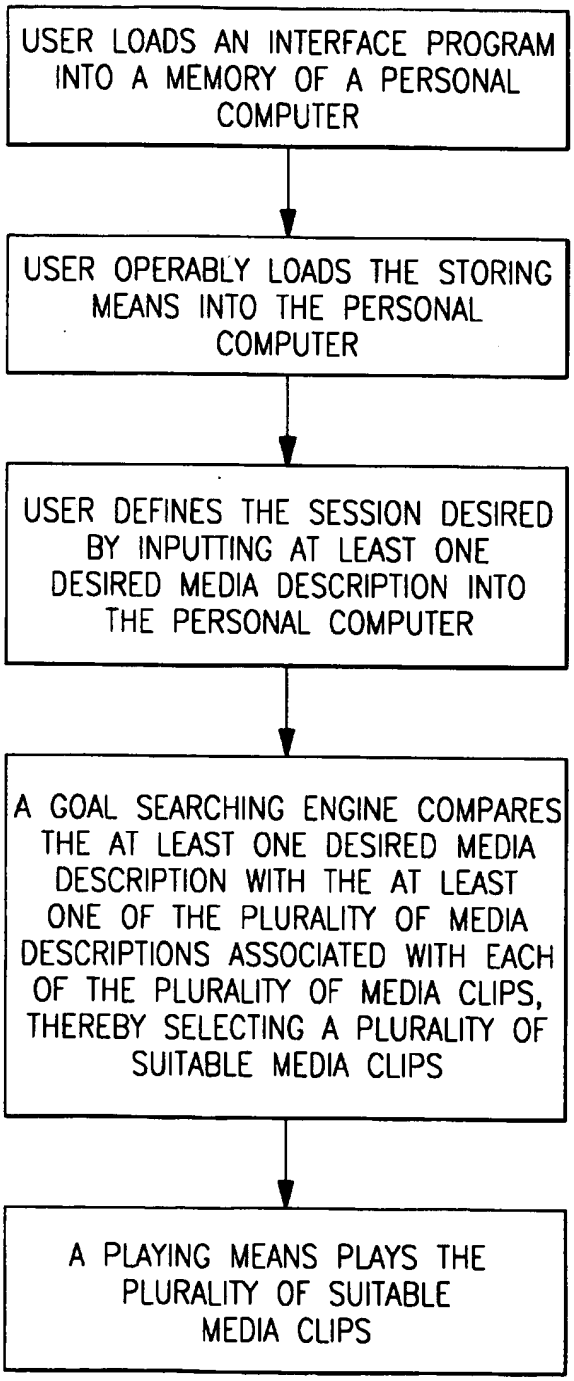

PROVIDE AT LEAST ONE MEDIA FILE
DEFINE A PLURALITY OF MEDIA CLIPS
PROVIDE A DEFINING MEANS FOR DEFINING AT LEAST TWO MEDIA SELECTION PARAMETERS, EACH OF THE AT LEAST TWO MEDIA SELECTION PARAMETERS HAVING A PLURALITY OF MEDIA DESCRIPTIONS
CREATE A DATABASE MEANS FOR ASSOCIATING EACH OF PLURALITY OF MEDIA CLIPS WITH AT LEAST ONE OF THE PLURALITY OF MEDIA DESCRIPTIONS
ASSOCIATE THE DEFINING MEANS AND THE DATABASE MEANS WITH A MEDIA ORGANIZATION FILE.
STORE THE AT LEAST ONE MEDIA FILE AND THE MEDIA ORGANIZATION FILE ON A STORING MEANS

Fig. 8


USER LOADS AN INTERFACE PROGRAM INTO A MEMORY OF A PERSONAL COMPUTER
USER OPERABLY LOADS THE STORING MEANS INTO THE PERSONAL COMPUTER
USER DEFINES THE SESSION DESIRED BY INPUTTING AT LEAST ONE DESIRED MEDIA DESCRIPTION INTO THE PERSONAL COMPUTER
A GOAL SEARCHING ENGINE COMPARES THE AT LEAST ONE DESIRED MEDIA DESCRIPTION WITH THE AT LEAST ONE OF THE PLURALITY OF MEDIA DESCRIPTIONS ASSOCIATED WITH EACH OF THE PLURALITY OF MEDIA CLIPS, THEREBY SELECTING A PLURALITY OF SUITABLE MEDIA CLIPS
A PLAYING MEANS PLAYS THE PLURALITY OF SUITABLE MEDIA CLIPS

GOAL SEEKING ENGINE AND METHOD FOR GENERATING CUSTOM MEDIA PRESENTATIONS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application for a utility patent is a continuation-in-part of a previously filed utility patent Application having application Ser. No. 09/562,244, filed Apr. 28, 2000.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH

Not Applicable

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to a method of formatting media files, and more particularly to a method of formatting media files such that a user can build custom media presentations from a plurality of media clips according to parameters specified by the user.

2. Description of Related Art

The following art defines the present state of this field:

Sawyer, U.S. Pat. No. 4,717,971, discloses a method for establishing an electronic picture file composed of a plurality of individual pictures stored on several disks. The method uses an editing procedure that is controlled by a plurality of attributes selected by the user. First, the user assigns a category to each picture. The user then has the option of specifying picture order, time allotted for viewing each picture and text to accompany each picture. The system generates an electronic picture file that is organized according to these parameters.

Richards, U.S. Pat. No. 5,301,172, discloses a method of storing multimedia clips "user information items") broken by inserted "selection points." A reproducing apparatus then reproduces the multimedia clips and allows the user to direct the course of the multimedia presentation by his or her responses at the selection points. Each selection point is capable of directing the multimedia presentation to a plurality of different multimedia clips.

Beitel, U.S. Pat. No. 5,339,423, discloses a computer/software system which enables a user to produce and display an audio/visual application using a library of image, audio and story objects.

Drake, U.S. Pat. No. 5,550,966, discloses an automated presentation capture system that captures and stores audio/video/presentation inputs and stores them in a database.

Gustman, U.S. Pat. No. 5,832,495, discloses cataloging multimedia data by labeling the different "elements" or pieces of each stream of media (audio, video, etc.) and associating keywords with each element. This data can be organized in a database and searched for the purpose of locating a specific element of multimedia.

Beitel, U.S. Pat. No. 5,274,758, discloses a user/PC interface system which enables the creation and performance of a synchronized audio/visual story on the PC. The system plays an audio presentation; and the audio presentation includes "labels" that, when played, trigger the generation of video images. Since the video images are displayed when triggered by the "label", the entire presentation is synchronized.

Etra, U.S. Pat. No. 5,012,334, discloses a video image bank system for preparing an edit tape and associated edit list from a library of stock video image sequences.

Isadore-Barreca, U.S. Pat. No. 5,590,262. discloses an interactive video creation method for constructing an interactive video interface having a primary video layer, a library layer and a resource data base layer.

Ettlinger, U.S. Pat. No. 4,746,994, discloses a videotaped-based editing system that uses a plurality of video recorders and a computer-based operator's console to allow easier editing.

Pooser, U.S. Pat. No. 5,812,134, discloses a 3-D display of the contents of a database. The 3-D display provides a user with both the "position" and relationships of the information unit being examined relative to the remainder of the database, as well as the information regarding the overall size and complexity of the database.

Nunally, U.S. Pat. No. 5,974,235, discloses techniques for storing video in a database and analyzing the video image data in order to detect significant features of the images. This system is useful for analyzing the videos produced by surveillance cameras to detect intruders.

The prior art teaches various methods of ordering media files. However, the prior art does not teach a method of formatting that allows a user to build a custom media presentation according to parameters specified by the user. The present invention fulfills these needs and provides further related advantages as described in the following summary.

SUMMARY OF THE INVENTION

The present invention teaches certain benefits in construction and use which give rise to the objectives described below.

The present invention provides a method of formatting at least one media file, the formatting allowing a user to build a custom media presentation according to parameters specified by the user. According to the method, a plurality of media clips are first defined from the at least one media file. At least two media selection parameters are then defined, each of the at least two media selection parameters having at least one of a plurality of media descriptions. Each of the plurality of media clips is then associated with at least one of the plurality of media descriptions. Once the at least one media file has been properly formatted, desired media parameters are received from the user. The method then teaches selecting a plurality of suitable media clips that are associated with the desired media descriptions, and playing the plurality of suitable media clips.

A primary objective of the present invention is to provide a method of formatting at least one media file having advantages not taught by the prior art.

Another objective is to provide a method of formatting at least one media file that allows a professional to organize and classify material so that a user can utilize a goal seeking search engine to create custom media presentations that meet the requirements of the user.

Other features and advantages of the present invention will become apparent from the following more detailed description, taken in conjunction with the accompanying drawings, which illustrate, by way of example, the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWING

The accompanying drawings illustrate the present invention. In such drawings:

FIG. 1 is a perspective view of the preferred embodiment of the present invention;

FIG. 2 is a block diagram thereof;

FIG. 3A is a table showing how each of a plurality of media clips is referenced to one of at least one media file;

FIG. 3B is a table showing how each of a plurality of media clips is referenced to one media file;

FIG. 4 is a table showing a defining means of a media organization file, the defining means including a plurality of media selection parameters, each of the plurality of media selection parameters having a plurality of media descriptions;

FIG. 5 is a table showing a database means of the media organization file;

FIG. 6 is a screen display generated by an interface program;

FIG. 7 is a flow diagram showing the steps used to produce the media organization file; and

FIG. 8 is a flow diagram showing the steps taken by a user to select and view a plurality of suitable media clips.

DETAILED DESCRIPTION OF THE INVENTION

The above described drawing figures illustrate the invention, a method for formatting at least one media file **32**, the formatting allowing a user **10** to build a custom media presentation according to at least two desired media descriptions **74** specified by the user **10**. In the preferred embodiment, the at least one media file **32** is formatted as described herein, and then played on a media system **20** that is capable of selecting, organizing, and playing a plurality of suitable media clips **82** drawn from at least one media file **32** according to the at least two desired media descriptions **74** entered by a user **10**.

The Media System

The media system **20** of the current invention takes a unique approach to data organization that is not shown in the prior art. The media system **20** organizes data by treating it like a four-dimensional object which can be "sliced" and reorganized as desired by the user **10** to create a custom media presentation that exactly meets the requirements of the user **10**. The four dimensions employed by the preferred embodiment of this technology are Width, Depth, Height, and Time. For purposes of this application, the four dimensions refer to the Topic of the media clip, the Complexity of the clip, the Order of the clips with respect to each other, and the length of Time of each clip. The specific dimensions employed, however, may be changed by those skilled in the art without avoiding the scope of this invention.

As shown in FIG. **1**, the media system **20** includes a means for storing **30** ("storing means") the at least one media file **32** and a media organization file **36**. The media organization file **36** includes a defining means **40** for defining at least two media selection parameters **42** (the dimensions), each of the at least two media selection parameters **42** having a plurality of media descriptions **44**. The media organization file **36** further includes a database means **46** for associating each of the plurality of media clips **34** with at least one of the plurality of media descriptions **44**.

The media system **20** further includes a means for receiving **70** ("receiving means") at least two desired media descriptions **74** from the user **10**, and a means for selecting **80** ("selecting means") the plurality of suitable media clips **82** from the plurality of media clips **34** based upon the at least two desired media descriptions **74**. In the preferred embodiment, the media system **20** further includes a means for playing **90** the plurality of suitable media clips **82**.

The Storing Means

The storing means **30** is preferably a digital storage media capable of storing both the at least one media file **32** and the media organization file **36**. The storing means **30** can be selected by those skilled in the art from a variety of suitable storage media, including magnetic storage disks, tapes, hard-drives, optical storage disks, memory chips, or other suitable media that are well known by those skilled in the art. In the preferred embodiment, as shown in FIG. **1**, the storing means **30** is a compact disk ("CD") which can be easily packaged, sold, and transported in the same way as traditional media.

Those skilled in the art can devise many forms of storing means **30**. Since the specific storing means **30** used is not critical to the novelty of the invention, any equivalent storing means **30** should be considered within the scope of this invention.

The Media File(s) and Media Clip(s)

As shown in FIG. **2**, the at least one media file **32** contains the content that is to be experienced by the user **10**. The at least one media file **32** can be any form of media that conveys information, including but not limited to text (such as .txt, .html, and .doc), audio (such as CD, .mp3, midi, and .wav), animation (such as flash), images (such as .jpeg and .gif) and video (such as DVD, MPEG, and .avi). The at least one media file **32** contains a plurality of media clips **34**. Each of the plurality of media clips **34** represents a specific user experience; and it is the selection and combination of the plurality of media clips **34** that creates the final work which is viewed by the user **10**.

As shown in FIG. **3A**, in the preferred embodiment the at least one media file **32** includes many media files, each media file functioning as one of the plurality of media clips **34**. While this embodiment increases the total storage space necessary to store all of the overlapping material in multiple files, it makes other aspects of the programming and function easier and faster, so this embodiment is currently preferred.

In an alternative embodiment, as shown in FIG. **3B**, the at least one media file **32** is one large file from the plurality of media clips **34** are drawn. For example, one clip could be defined as the first 30 seconds of the large file; and a second clip could be defined as starting at 30 seconds and continuing for 1 minute and 5 seconds. It is possible that two or more of the plurality of media clips **34** overlap. In an example of such a case, the third clip may be defined as starting after 1 minute and 35 seconds and continuing for 1 minute, while the fourth clip may be defined as starting after 1 minute and 45 seconds and continuing for 35 seconds. In this fashion, a single media file **32** can be "cut up" into the plurality of media clips **34**.

The Media Organization File

The media organization file **36** is used to enable the sorting and selection of the plurality of media clips **34**. The media organization file **36** is associated with a defining means **40** for defining at least two media selection parameters **42**. Each of the at least two media selection parameters **42** has a plurality of media descriptions **44**. Those skilled in the art can devise a variety of media selection parameters **42**, and the parameters can vary depending upon the nature of the plurality of media clips **34** and the intended use of the media system **20**.

In the preferred embodiment, as shown in FIG. **4**, the at least two media selection parameters **42** include a topic parameter **50** having at least one topic **52**, a complexity parameter **54** having at least one complexity rating **56**, an order parameter **60** having at least one order rating **62**, and

a time parameter **64** having a length of time **66**. The at least one topic **52** preferably includes various major topics, as one would expect to see in a table of contents. The at least one complexity rating **56** and the at least one order rating **62** are preferably numerals within the range of 1–10. The length of time **66** is preferably a numeric measurement of time in an appropriate interval length. A further discussion of these parameters, as well as a practical example, is provided below.

The media organization file **36** further includes a database means **46** for associating each of the plurality of media clips **34** with at least one of the plurality of media descriptions **44**. In the preferred embodiment, the database means **46** associates each of the plurality of media clips **34** with at least one of the at least one topic **52**, at least one of the at least one complexity rating **56**, at least one of the at least one order rating **62**, and the length of time **66**.

In a simple embodiment, as shown in FIG. **5** and as discussed below, the database means **46** is shown in a simple table assigning at least one of the plurality of media descriptions **44** to each of the plurality of media clips **34**. It is important to recognize that this is a simple example—in a preferred embodiment of this technology, it is expected that the database means **46** will include a complex relational database to provide the most effective results from any given search. In such a relational database, each of the plurality of media clips **34** is associated with a different one of the plurality of media descriptions **44** depending upon the context of the search. The construction of such a relational database, according to the teachings of this invention, is within the abilities of those skilled in the art and thus does not require a more detailed discussion.

The Interface Program

As shown in FIG. **6**, the receiving means **70** functions to receive the at least two desired media descriptions **74** from the user **10**. Each of the at least two desired media descriptions **74** corresponds to one of the at least two media selection parameters **42**. In the preferred embodiment, the at least two desired media descriptions **74** include a desired topic **75**, a desired complexity **76**, and a desired play length **78**. By inputting this information, the user **10** is able to control the output of the media system **20** so the user **10** can select only appropriate portions of the media content.

As shown in FIG. **1**, the receiving means **70** is preferably a personal computer having a memory **70A**, a processor **70B** and an interface program **73** operably installed to function thereon. The personal computer **70** is operably connected to a data input mechanism **72**, such as a keyboard **72** and a mouse **72A**. While the keyboard **72** and the mouse **72A** are preferred, those skilled in the art can devise many equivalent mechanisms, such as a microphone and voice recognition software (not shown), and such equivalent embodiments are within the scope of the claimed invention. Since such computers and peripherals are well known in the art, a further detailed description is not required.

As shown in FIG. **6**, the interface program **73** draws upon the media organization file **36** to produce a screen display on the monitor **90**. The screen display allows the user **10** to use the keyboard **72** and the mouse **72A** to input the desired media descriptions **74**. In the preferred embodiment, the interface program **73** draws upon the media organization file **36** to produce a screen display on the monitor **90** that lists the at least one topic **52** and the at least one complexity rating **62**.

Through the personal computer **70** and the keyboard **72** and the mouse **72A**, the user **10** is able to input the desired media descriptions **74** into the interface program **73**. In the preferred embodiment, the user **10** simply selects the desired media descriptions **74** from the plurality of media descriptions **44** and by inputting the desired play length **78**, as shown in FIG. **6**. While it is preferred that the user **10** directly manipulate the desired media descriptions **74**, for maximum control, it should be noted that many forms of "front end" can be placed on this type of system without altering the fundamental structure of the media system **20**. For example, in another embodiment the user **10** might input a "plain English" description of the presentation he or she would like. An artificial intelligence built into the interface program **73** would then determine the desired media descriptions **74** based upon techniques that are known to those skilled in the art. The selections made by the user **10** are inputted into the goal seeking engine **80**, as described below.

The Goal Seeking Engine

The selecting means **80** is used for selecting a plurality of suitable media clips **82** from the plurality of media clips **34**. The selecting means **80**, a critical component of the media system **20**, functions by comparing the plurality of desired media descriptions **74** with the plurality of media descriptions **44** and selecting the suitable media clips **82** that match the selected criteria. The selecting means **80** preferably includes a goal seeking engine **84** for performs several selection steps. First, the goal seeking engine **84** selects, from the plurality of media clips **34**, only those media clips that are associated with the at least one topic **52** that matches the desired topic **75**.

Second, from those media clips that are associated with the at least one topic **52**, selecting only those media clips that are associated with the at least one complexity rating **56** that matches the desired complexity **76**. It is important to understand that simply selecting certain complexity ratings **56** is a simplification of the final commercial product. In the preferred embodiment, the goal seeking engine **80** does not just select certain numbers, but uses mathematical averaging to select a range of numbers whose average approximately matches the desired complexity **76**. The user **10** ultimately has control over the range of discretion allowed the goal seeking engine **80**, and in the preferred embodiment the user **10** can adjust the "advanced controls" of the goal seeking engine **80** to fine tune the amount of variation that the goal seeking engine **80** is allowed.

Third, from those media clips that are associated with both the at least one topic **52** that matches the desired topic **75** and the at least one complexity rating **56** that matches the desired complexity **76**, the goal seeking engine **80** selects the plurality of suitable media clips **82** which are not duplicates, based on the order rating **62**, and the sum of whose length of time **66** is approximately equal to the desired play length **78**. Finally, the plurality of suitable media clips **82** are ordered based on the order rating **62**. Once again, a linear solution to the process of ordering the plurality of suitable media clips **82** is a simplified version of the preferred embodiment. In the preferred embodiment, the goal seeking engine **80** uses relational database techniques to assign different order ratings **62** to each of the plurality of suitable media clips **82** based upon which other media clips have been selected.

The goal seeking engine **84** preferably includes a software program that implements a knapsack algorithm. The knapsack algorithm **84** sorts the potentially available combinations of the plurality of media clips **34** to select the plurality of suitable media clips **82** that most closely match the requested characteristics, yet still fit within the desired play length **78**. The knapsack algorithm **84**, or an equivalent, is critical because it is expected that, in many searches, many

of the plurality of media clips **34** meet the requirements described by the user **10**—and it is necessary to select only some of the plurality of media clips **34** to arrive at a result that matches the length of time **66** requested by the user **10**. The knapsack algorithm **84** sorts these possibilities and determines a combination that most closely fits the needs of the user **10**. A more detailed discussion of the knapsack algorithm **84** is contained in Algorithms, A Functional Programming Approach, 2d Edition, by Fethi Rabhi and Guy Lapalme, hereby incorporated by reference in full.

The knapsack algorithm **84** preferably also has the ability to allow for repetition of material to create the most effective final product. In the preferred embodiment, in cases in which the sum of the lengths of time **66** of the plurality of suitable media clips **82** is less than the desired play length **78**, or when otherwise suitable, the goal seeking engine **84** has the ability to insert additional media clips which either overlap or are duplicates of one or more of the plurality of suitable media clips **82**. Suitable duplicates can be determined based upon the desired topic **74**, the desired complexity **76**, the length of time **66**, and the order parameter **60** associated with each of the clips. For example, if the media organization file **36** shows that two of the plurality of media clips **34** overlap and have the same order parameter **60**, with one clip being 5 minutes and the second being 2 minutes, the goal seeking engine **84** will initially select the 5 minute clip for display. Then, if there is additional time available, the goal seeking engine **84** might select the 2 minute segment to repeat and emphasize the point. This is particularly likely to occur if the 2 minute media clip contains information that is close to the complexity or interest specified by the user **10**.

In many cases, the knapsack algorithm **84** can sort the results of a search to create a media experience in which the sum of the length of time **66** of all of the plurality of suitable media clips **82** is almost exactly equal to the desired play length **78**. However, it is only required that the sum of the length of time **66** of all of the plurality of suitable media clips **82** be approximately equal to the desired play length **78**. For purposes of this invention, the sum need only roughly approximate the desired play length **78**. In some searches, there may be a substantial difference between the sum and the desired play length **78**. In the preferred embodiment, the user **10** can control how close that goal seeking engine **80** can come to its goal. For example, the user **10** might request a 30 minute presentation and allow 15 minutes in variation. In another example, the user might request a 2 minute presentation that must be exactly 2 minutes. In most cases, the goal seeking engine **80** should be able to very closely meet even the most stringent requirements of the user **10**; however, greater processing time will be required to meet stringent search criteria. A carefully prepared and formatted media organization file **36** makes it possible for the sum and the desired play length **78** to be nearly exactly equal.

Much of the success of the media system **20** depends upon the creation and editing of the media organization file and the plurality of media clips **34**. If the plurality of media clips **34** are long and not skillfully edited, the search results will be of lower quality. It is worth noting, however, that a poorly executed search engine, which are not efficient in this matching step, should still considered within the scope of this invention. The requirement that "the sum of the length of time **66** of all of the plurality of suitable media clips **82** be approximately equal to the desired play length **78**" should not be construed as requiring that another search engine be effective in matching the sum and the desired play length **78** in order to infringe. It is also worth noting that if the user **10** requests a very narrow field of data and the desired play length **78** is very large, the media presentation may be significantly shorter than the desired play length **78**; although the use of repetition by the goal seeking engine **80** could potentially alleviate the disparity.

The Media Player

In the preferred embodiment, the media system **20** further includes a means for playing **90** the plurality of suitable media clips **82**. In the preferred embodiment, the playing means **90** is a monitor **90** and a pair of speakers **90A** that are operatively attached to the personal computer **70**. The monitor **90** and the pair of speakers **90A** are well known in the prior art and do not constitute an inventive aspect of the invention. It is possible that many devices might be devised by those skilled in the art to play the media formatted according to the teachings of this invention, and these alternative embodiments should be considered within the scope of this invention.

The Method of Use

In an example of a practical application of this technology, we will describe the use of the above-described technology to format and view a movie about Abraham Lincoln.

According to the teachings of this invention, as shown in FIG. **7**, the movie is first segmented into the plurality of files **32**, each of the plurality of files **32** containing a discrete segment of the movie and representing one of the plurality of media clips **34**. Determining how to properly edit and select each of the plurality of media clips **34** requires a great deal of skill, creativity and experience, so it expected that this will be performed by a professional.

The professional then creates the defining means **40** to define the at least two media selection parameters **42** and their respective plurality of media descriptions **44**. According to the preferred embodiment, the media selection parameters **42** include at least one topic **52**, a complexity parameter **54** having at least one complexity rating **56**, an order parameter **60** having at least one order rating **62**, and a time parameter **64** having a length of time **66**; however, it should be kept in mind that other parameters may be devised by those skilled in the art.

In the current example involving the life of Abraham Lincoln, the professional could then create topics **52** that are relevant to the life of Abraham Lincoln, such as a birth topic, an early childhood topic, an early presidency topic, a civil war topic, a slavery topic, and a death topic. The professional would then define the complexity rating **56**, such as 1–10, with 1 including very general information and 10 including very specific details. Finally, the professional would then define the at least one order rating **62**, such as a scale of 1–100, with 1 including being the first clip in the story and 100 being the last clip. As described above, the use of a linear scale is a simplified version to facilitate understanding of the invention. In the preferred embodiment, the database means **46** would be a relational database would allow the plurality of media clips **34** to be organized relative to each other, allowing a large plurality of complexity ratings **56** and order ratings **62** to be associated with each of the plurality of media clips **34**.

Once the defining means **40** has been created, each of the plurality of media clips **34** is then categorized in the database means **46**. In this step, each of the plurality of media clips **34** is then associated with at least one of the at least one topic **52**, at least one of the at least one complexity rating **56**, and at least one of the at least one order rating **62**. Completing the relational database **46** described above would often be a long and difficult task, but it would provide the best response to the query of the user **10**. Finally, each of the plurality of media clips **34** is associated with the length of time **66** of the media clip, which is objectively determined.

Following the example described above, FIG. **5** shows a sample table categorizing four media clips. The first media clip, 10 minutes generally describing the birth of Abraham Lincoln, is categorized under the topic of birth, with a

complexity of 1, and order of 1, and a time of 10 minutes. The second media clip, a 5 minute segment of the first media clip which eliminates some of the background material included in the first clip, is categorized under the topic of birth, with a complexity of 1, and order of 1, and a time of 5 minutes. The third media clip, a 2 minute clip generally describing the assassination of Abraham Lincoln, is categorized under the topic of death, with a complexity of 1, and order of 89, and a time of 2 minutes. The fourth media clip, a 2 minute clip describing certain particular details of the assassination, is categorized under the topic of death, with a complexity of 8, and order of 92, and a time of 2 minutes.

Once the professional has constructed the media organization file **36**, it is stored on the storing means **30** along with the plurality of media clips **34**. According to the preferred embodiment of this invention, the storing means **30** is a CD which is then distributed to consumers who are interested in the life of Abraham Lincoln. As described above, it is equally acceptable to distribute the described files via the global computer network or another known method of data distribution.

The user **10** then loads the described files into the personal computer **70** by inserting the CD **30**, downloading the file, and activating the interface program **73**. As shown in FIG. **6**, the user **10** is presented the list of selections described above. Based upon the input of the user **10**, as shown in FIG. **8**, the goal searching engine means **84** selects the plurality of suitable media clips **82** for transmission to the playing means **90**.

In the current example, the user **10** might select a 15 minute overview of the life of Lincoln. In this case, the goal seeking engine **84** would select clips 1 and 3 because they are of suitable complexity, and play clip 1 and then clip 3 based on their order. Clip number 2 would be rejected based upon the order parameter **60** because the goal searching engine would recognize that clips 1 and 2 are duplicates, and clip 1 is of a more suitable length. If the user **10** had requested only 7 minutes of presentation, the goal searching engine means **84** would elect clips 2 and 3 as a more suitable combination.

Once the user **10** had viewed the overview, he or she may request 2 minutes of further details of the death of Lincoln, in which case the goal searching engine would reject clips 1 and 2 as the incorrect topic, but play clip 4 based upon meeting the stated criteria and meeting the time restrictions.

Of course, a typical product would often contain many hundreds or even thousands of media clips **34**, allowing extremely complex presentations that can be customized in any respect to the needs of the user **10**. This exceptional flexibility and customization allow enormous amounts of data to be readily searched, even by those unfamiliar with the field of the material, because the material has already been classified and organized by the professional that is knowledgeable in the field.

Other Embodiments

While we have referred to the distribution of a CD **30** having at least one media file **32** that can then be customized by the user **10**, it is also possible to utilize this technology in other ways. In an alternative embodiment, the storing means **30** is a central computer hard-drive of a central computer (not shown) operably connected to at least one personal computer **70** via a network such as a global computer network. The central computer (not shown) is programmed by one skilled in the art to directly download data to any of the personal computers that request the data. In one embodiment, the central computer downloads the at least one media file **32** and the media organization file **36** to the hard-drive or RAM of one of a network of personal computers via a global computer network. In another embodiment, the at least one media file **32** and the media organization file **36** remain resident on the central computer, and only the plurality of suitable media clips **82** are transmitted to the personal computer, via either download or streaming technologies. As will be recognized by those skilled in the art, this allows content providers to sell content in small and customized packages rather than just in bulk. The user **10** could obtain a small segment of content, presumably for a lower cost, rather than be required to purchase an entire work. It also allows the content provider to collect fees for each segment of the work, rather than only one fee for the entire work.

While the invention has been described with reference to at least one preferred embodiment, it is to be clearly understood by those skilled in the art that the invention is not limited thereto. Rather, the scope of the invention is to be interpreted only in conjunction with the appended claims.

What is claimed is:

1. A method for playing a selected portion of at least one media file, the method comprising the steps of:

defining a plurality of media clips from the at least one media file;

defining at least one topic, at least one complexity rating, and at least one order rating, the at least one complexity rating providing a rating of the complexity of one of the plurality of media clips, the at least one order rating defining a presentation sequence of the plurality of media clips;

measuring each of the plurality of media clips to determine a length of time of each of the plurality of media clips;

providing a database means for associating each of the plurality of media clips with one of the at least one topics, one of the at least one complexity ratings, one of the at least one order ratings, and the length of time measured;

associating, in the database means, each of the plurality of media clips with the length of time measured;

associating, in the database means, each of the plurality of media clips with at least one of the at least one topic;

associating, in the database means, each of the plurality of media clips with at least one of the at least one complexity rating;

associating, in the database means, each of the plurality of media clips with at least one of the at least one order rating;

providing a goal seeking engine;

receiving, into the goal seeking engine, a desired topic, a desired complexity, and a desired play length, the goal seeking engine performing the steps of:

selecting from the plurality of media clips only those media clips that are associated with the at least one topic that matches the desired topic;

selecting from those media clips that are associated with the at least one topic only those media clips that are associated with the at least one complexity rating that matches the desired complexity;

selecting, from those media clips that are associated with both the at least one topic that matches the desired topic and the at least one complexity rating that matches the desired complexity, a plurality of suitable media clips which are not duplicates, based on the order rating, and the sum of whose length of time is approximately equal to the desired play length;

sorting the plurality of suitable media clips based on the order rating; and

playing the plurality of suitable media clips.

* * * * *

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(12) **United States Patent**
Naim

(10) **Patent No.: US 6,694,200 B1**
(45) **Date of Patent: Feb. 17, 2004**

(54) **HARD DISK BASED PORTABLE DEVICE**

(75) Inventor: **Ari B. Naim**, Secaucas, NJ (US)

(73) Assignee: **Digital5, Inc.**, Lawrenceville, NJ (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/441,267**

(22) Filed: **Nov. 16, 1999**

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(60) Provisional application No. 60/134,989, filed on May 20, 1999, and provisional application No. 60/129,003, filed on Apr. 13, 1999.

(51) **Int. Cl.**[7] **G06F 17/00**
(52) **U.S. Cl.** **700/94**; 711/115
(58) **Field of Search** 700/94; 704/270, 704/272, 278; 711/112, 115, 100

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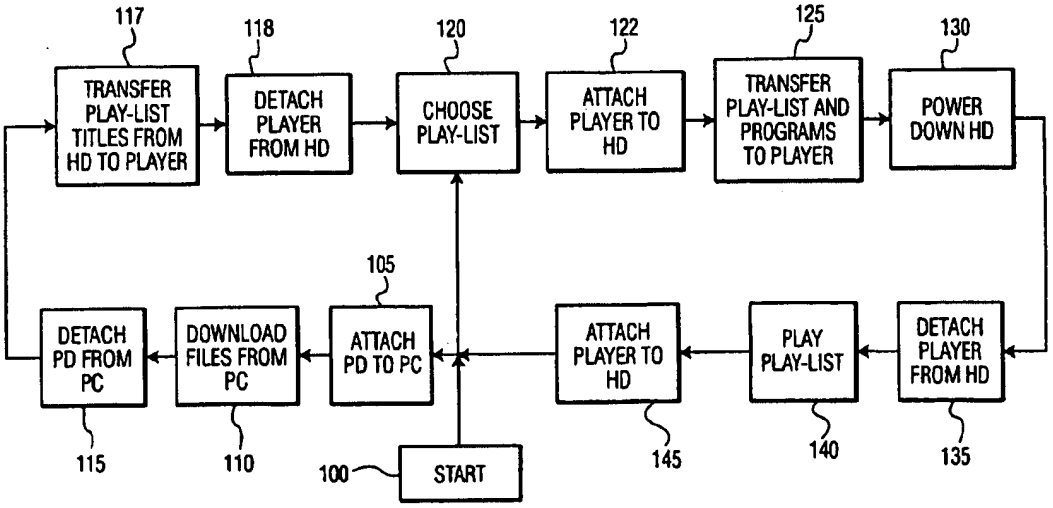
Primary Examiner—Xu Mei
(74) *Attorney, Agent, or Firm*—RatnerPrestia

(57) **ABSTRACT**

A portable device including a player capable of playing and recording digital data and a hard disk connected to the player for storing a relatively large capacity of digital data that can be transferred to and from the player. The hard disk is dedicated to the storage of digital data and program files for use with the player. The portable device can include a player and hard disk that are selectively detachable from one another. Alternatively, the player and hard drive can include an integrated construction wherein the player and the hard disk are incorporated into a single housing, preferably having a single circuit, such as a printed circuit board (PCB). In the integrated portable device, the typical electronics for managing the data on a hard drive are preferably integrated with the recording, playing, or displaying electronics. In addition, certain electronic components may be shared by the hard disk controller and player electronics, thus further reducing the cost and size of the portable device. This creates a more tightly integrated solution that benefits from further power consumption reduction, lower cost and smaller size. Methods of playing, recording, and downloading data are also disclosed. Digital data stored on the hard disk can be transferred to a memory of the player for playback by the player device. Data can be recorded using the player and then transferred and stored on the hard disk. The hard disk can be coupled to an external communications device and digital data can be downloaded to the hard disk for later use on the player.

25 Claims, 8 Drawing Sheets



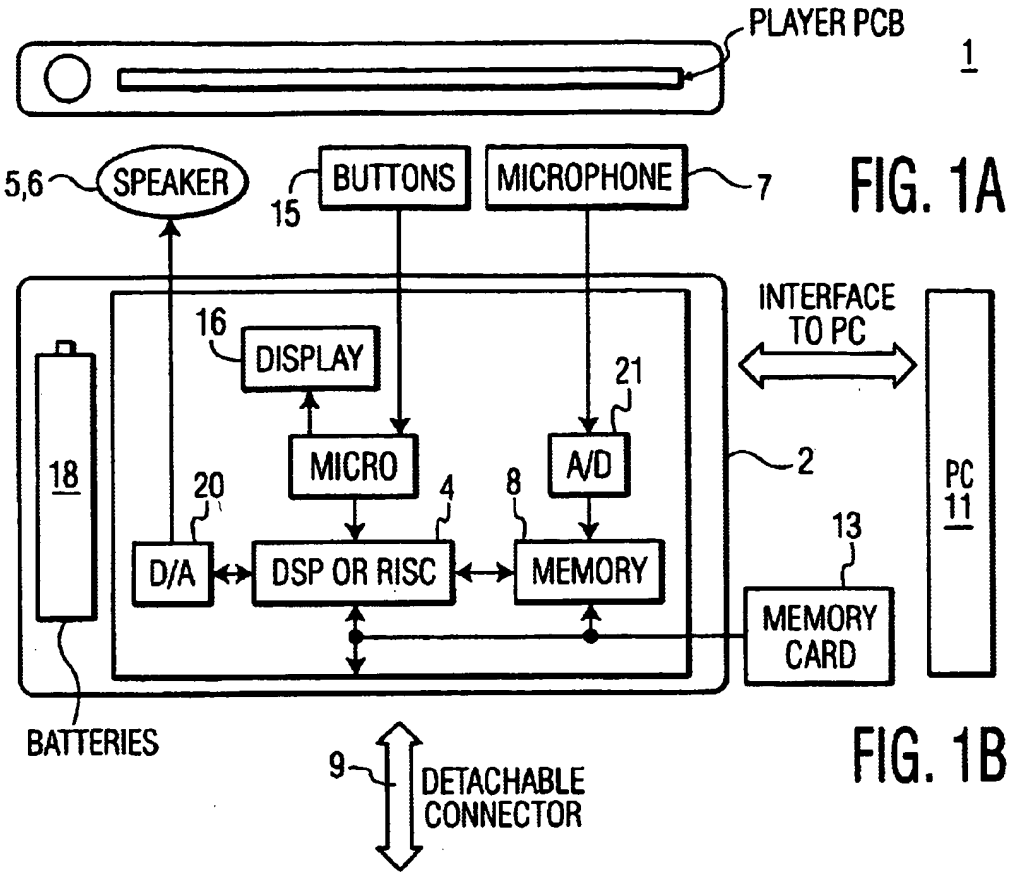


FIG. 1A

FIG. 1B

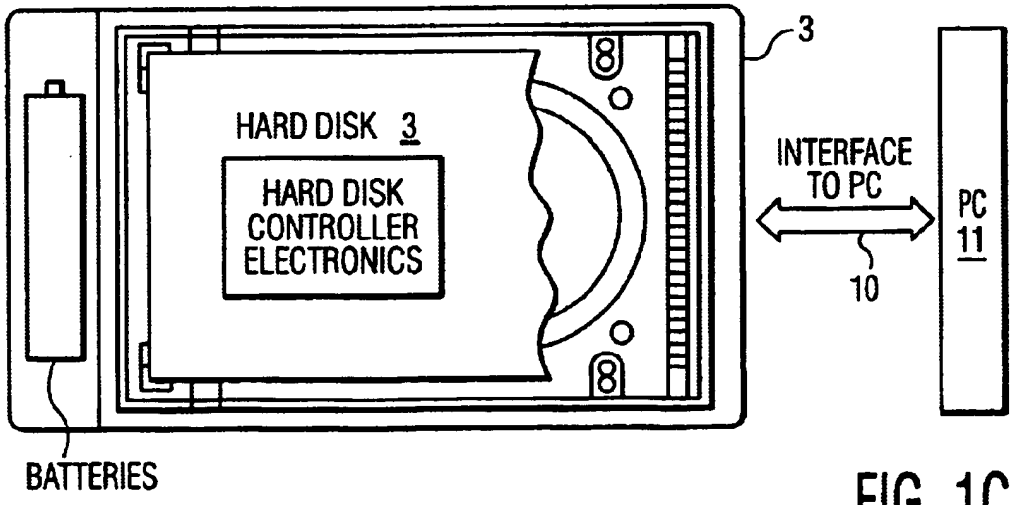


FIG. 1C

FIG. 1D

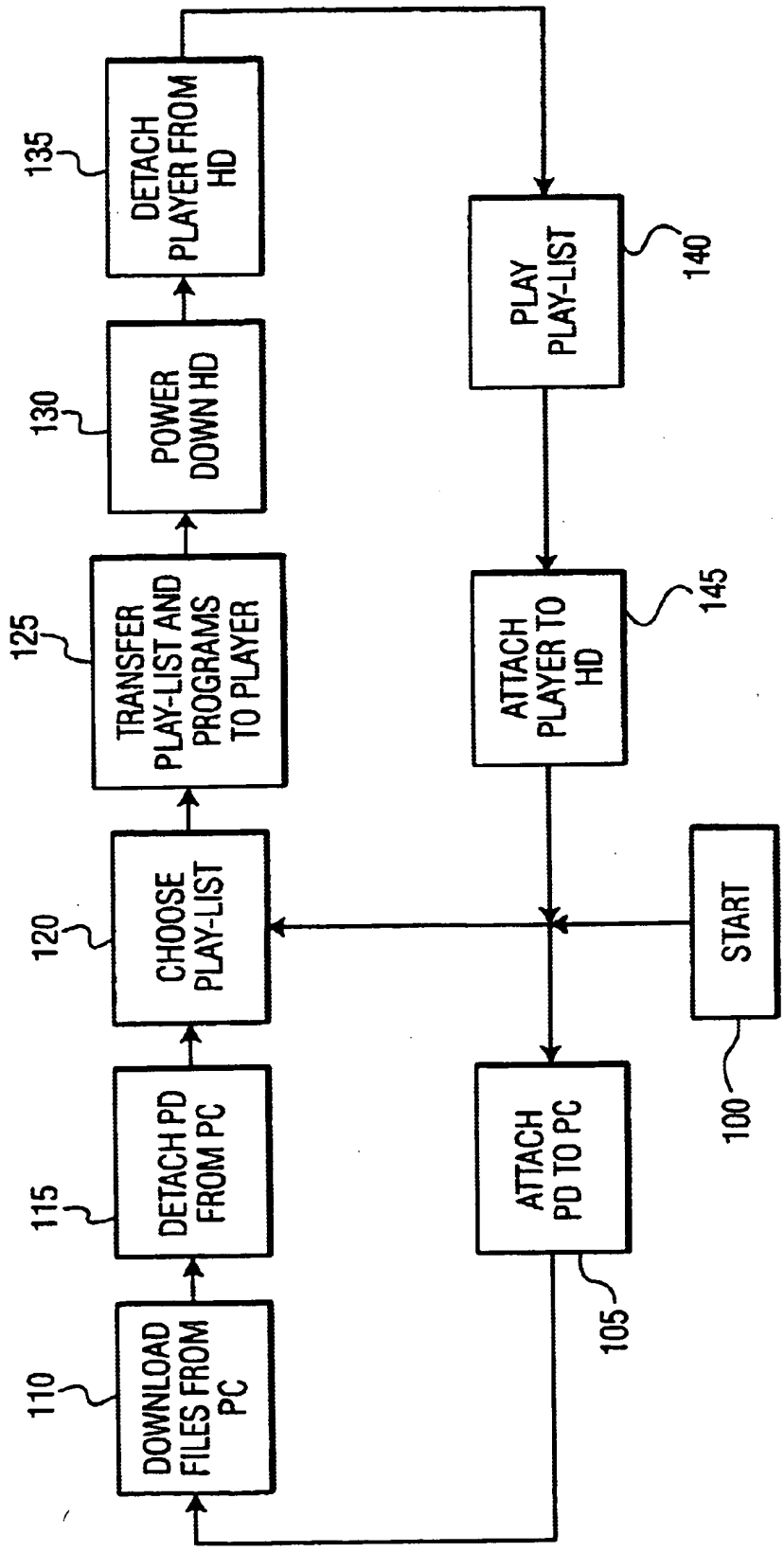

DOWNLOAD FILES FROM PC
110
DETACH PD FROM PC
115
CHOOSE PLAY-LIST
120
TRANSFER PLAY-LIST AND PROGRAMS TO PLAYER
125
POWER DOWN HD
130
DETACH PLAYER FROM HD
135
ATTACH PD TO PC
105
ATTACH PLAYER TO HD
145
PLAY PLAY-LIST
140
START
100

FIG. 2A

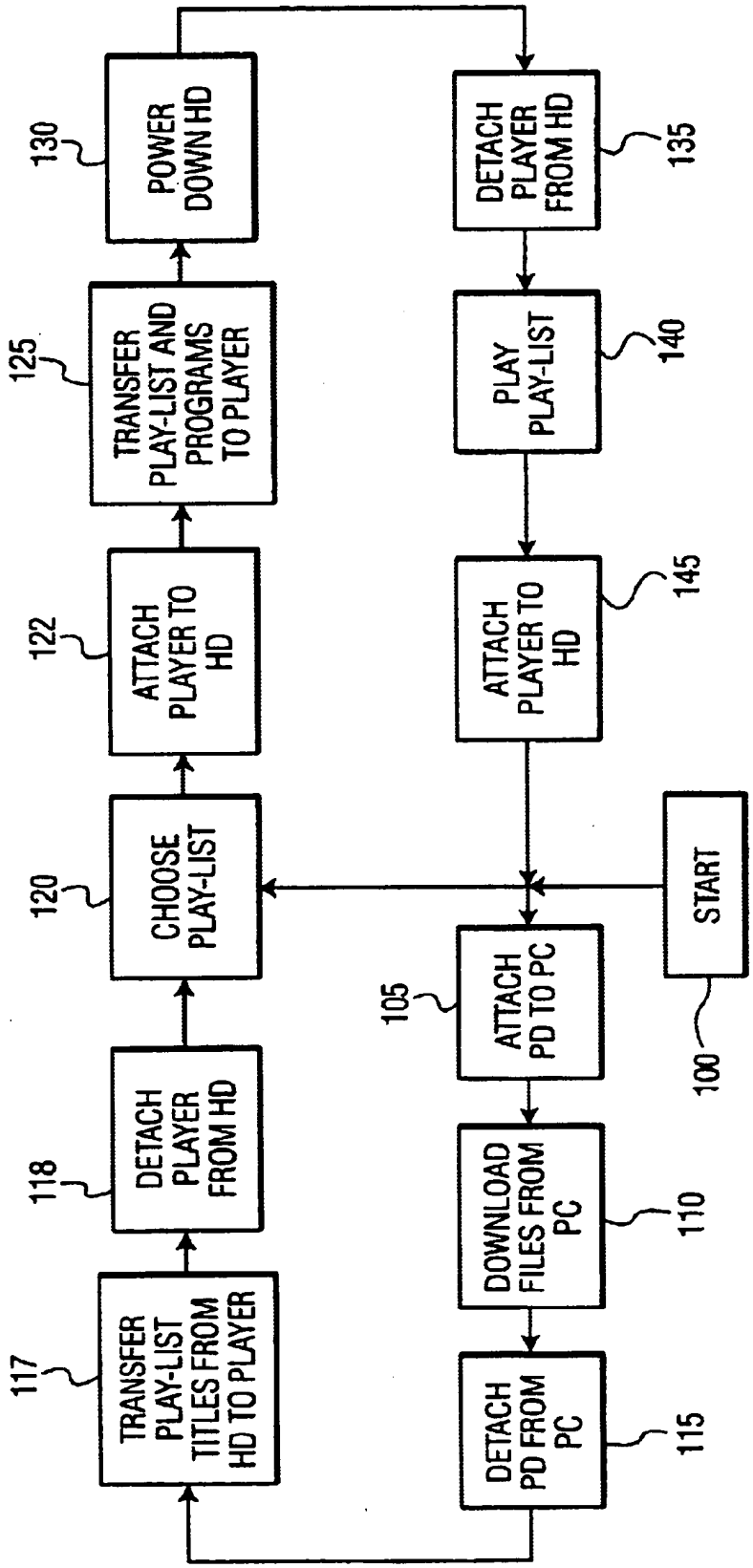

130
POWER DOWN HD
125
TRANSFER PLAY-LIST AND PROGRAMS TO PLAYER
122
ATTACH PLAYER TO HD
120
CHOOSE PLAY-LIST
118
DETACH PLAYER FROM HD
117
TRANSFER PLAY-LIST TITLES FROM HD TO PLAYER
135
DETACH PLAYER FROM HD
140
PLAY PLAY-LIST
145
ATTACH PLAYER TO HD
START
100
105
ATTACH PD TO PC
110
DOWNLOAD FILES FROM PC
115
DETACH PD FROM PC

FIG. 2B

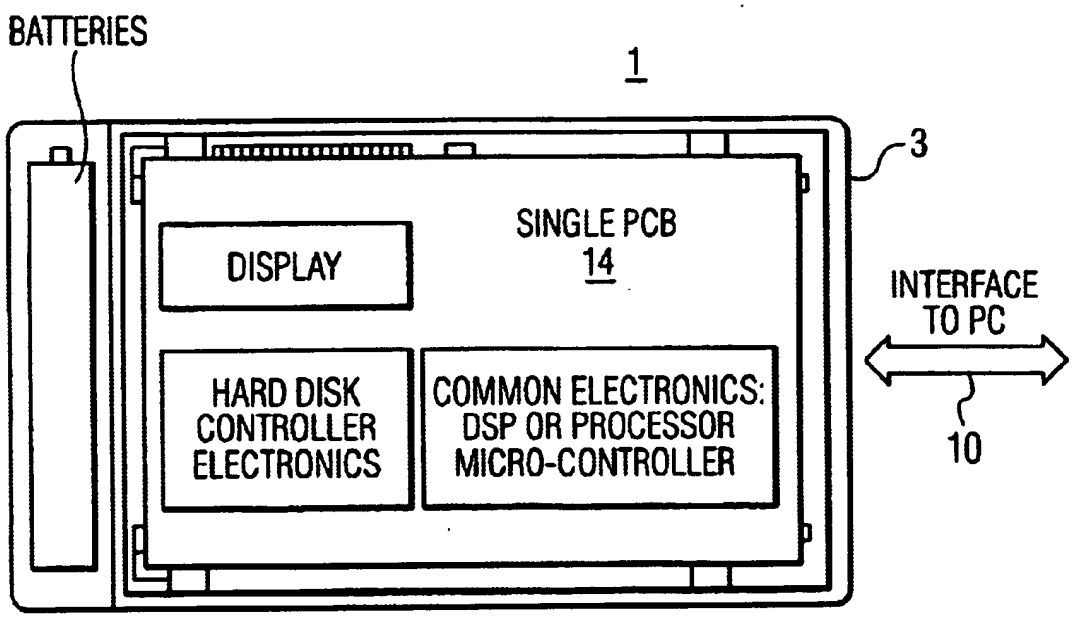

BATTERIES
1
3
SINGLE PCB
14
DISPLAY
INTERFACE
TO PC
HARD DISK
CONTROLLER
ELECTRONICS
COMMON ELECTRONICS:
DSP OR PROCESSOR
MICRO-CONTROLLER
10

FIG. 3A

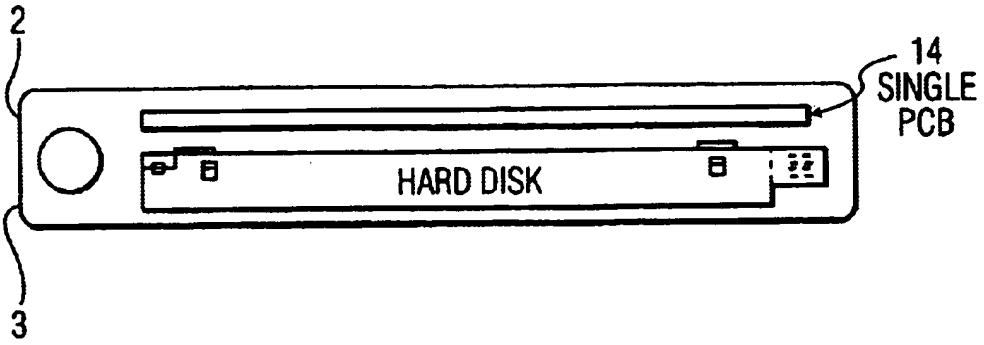

2
14
SINGLE
PCB
HARD DISK
3

FIG. 3B

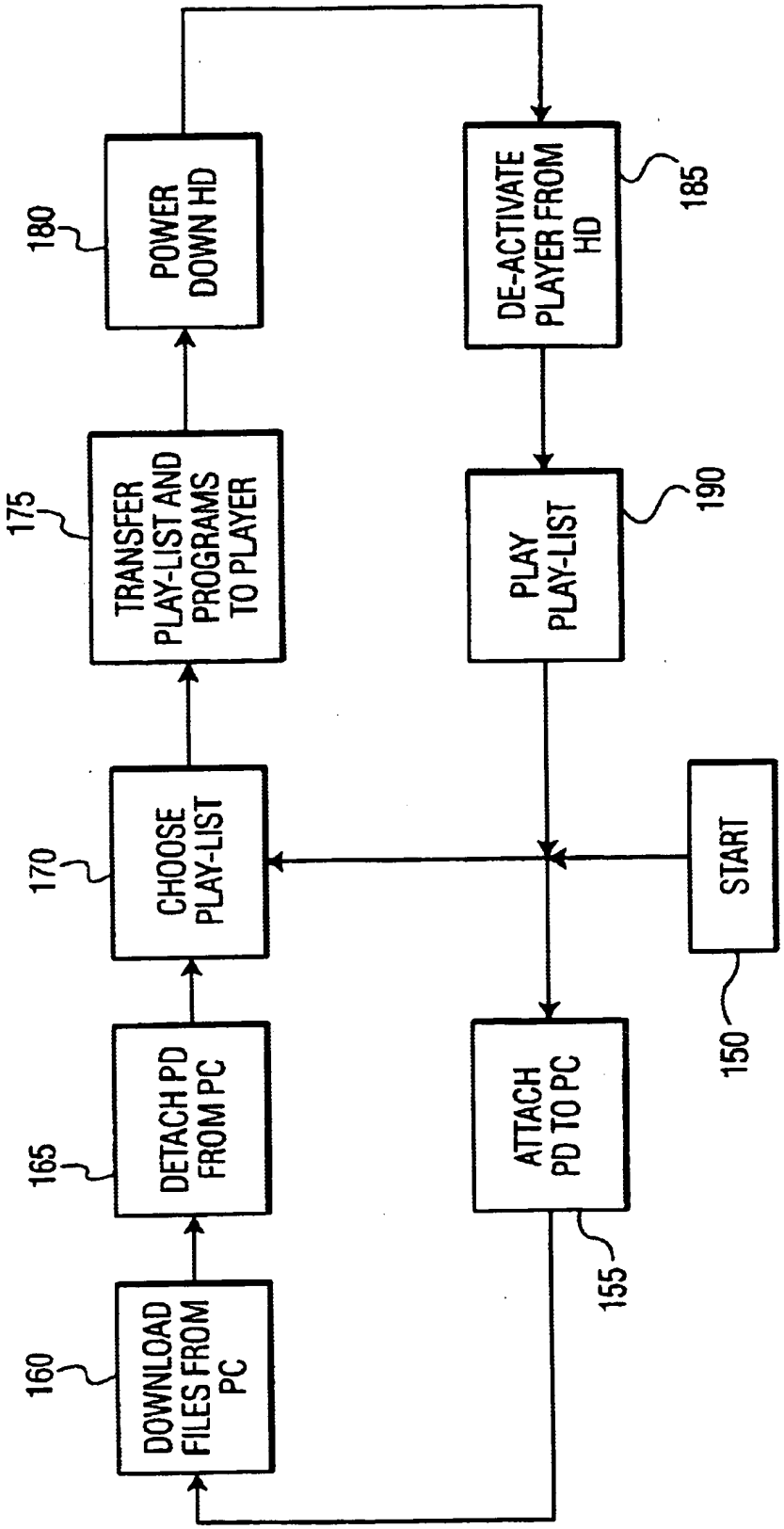

POWER DOWN HD
180
DE-ACTIVATE PLAYER FROM HD
185
TRANSFER PLAY-LIST AND PROGRAMS TO PLAYER
175
PLAY PLAY-LIST
190
CHOOSE PLAY-LIST
170
START
150
DETACH PD FROM PC
165
ATTACH PD TO PC
155
DOWNLOAD FILES FROM PC
160

FIG. 4A

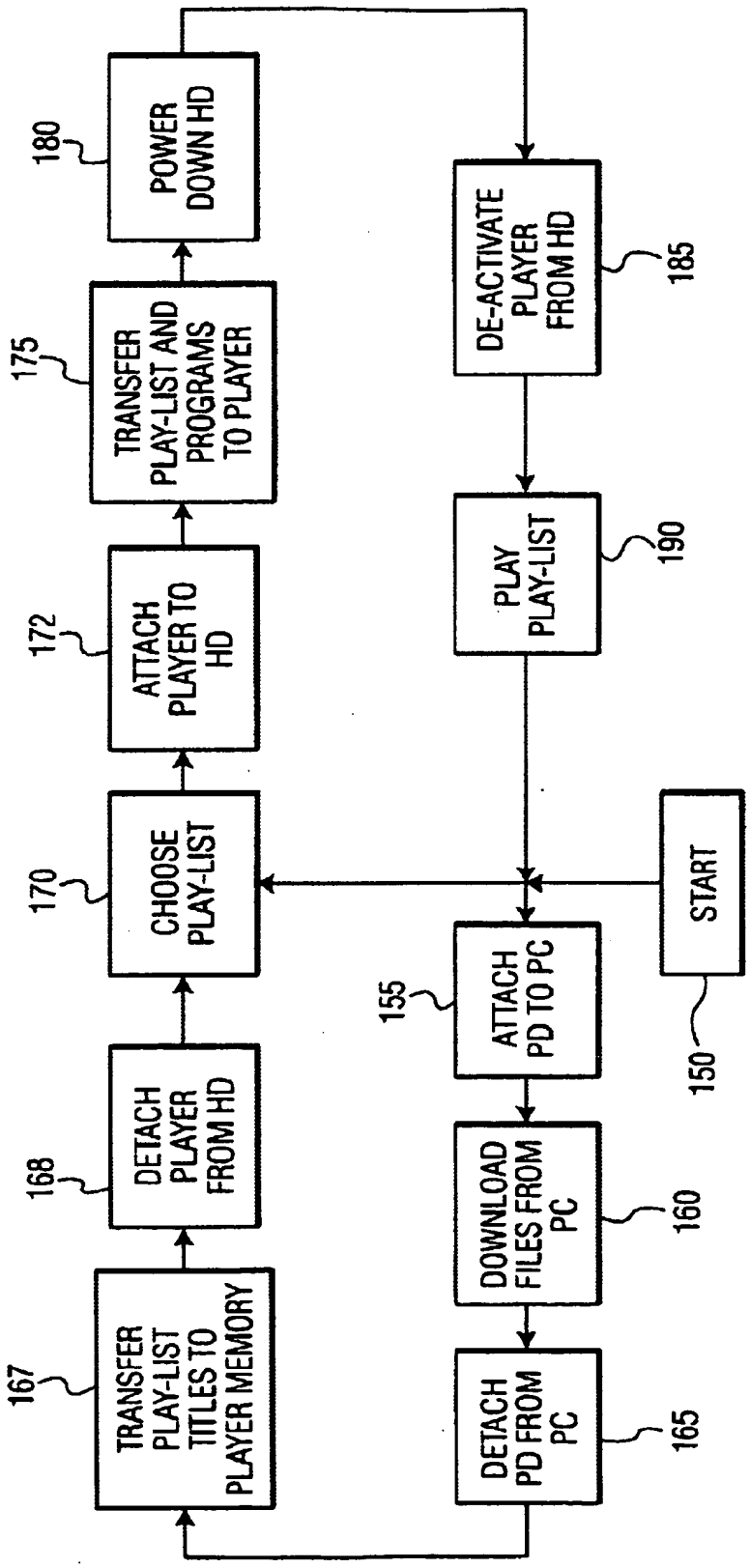

180
POWER DOWN HD
175
TRANSFER PLAY-LIST AND PROGRAMS TO PLAYER
172
ATTACH PLAYER TO HD
170
CHOOSE PLAY-LIST
168
DETACH PLAYER FROM HD
167
TRANSFER PLAY-LIST TITLES TO PLAYER MEMORY
185
DE-ACTIVATE PLAYER FROM HD
190
PLAY PLAY-LIST
150
START
155
ATTACH PD TO PC
160
DOWNLOAD FILES FROM PC
165
DETACH PD FROM PC

FIG. 4B

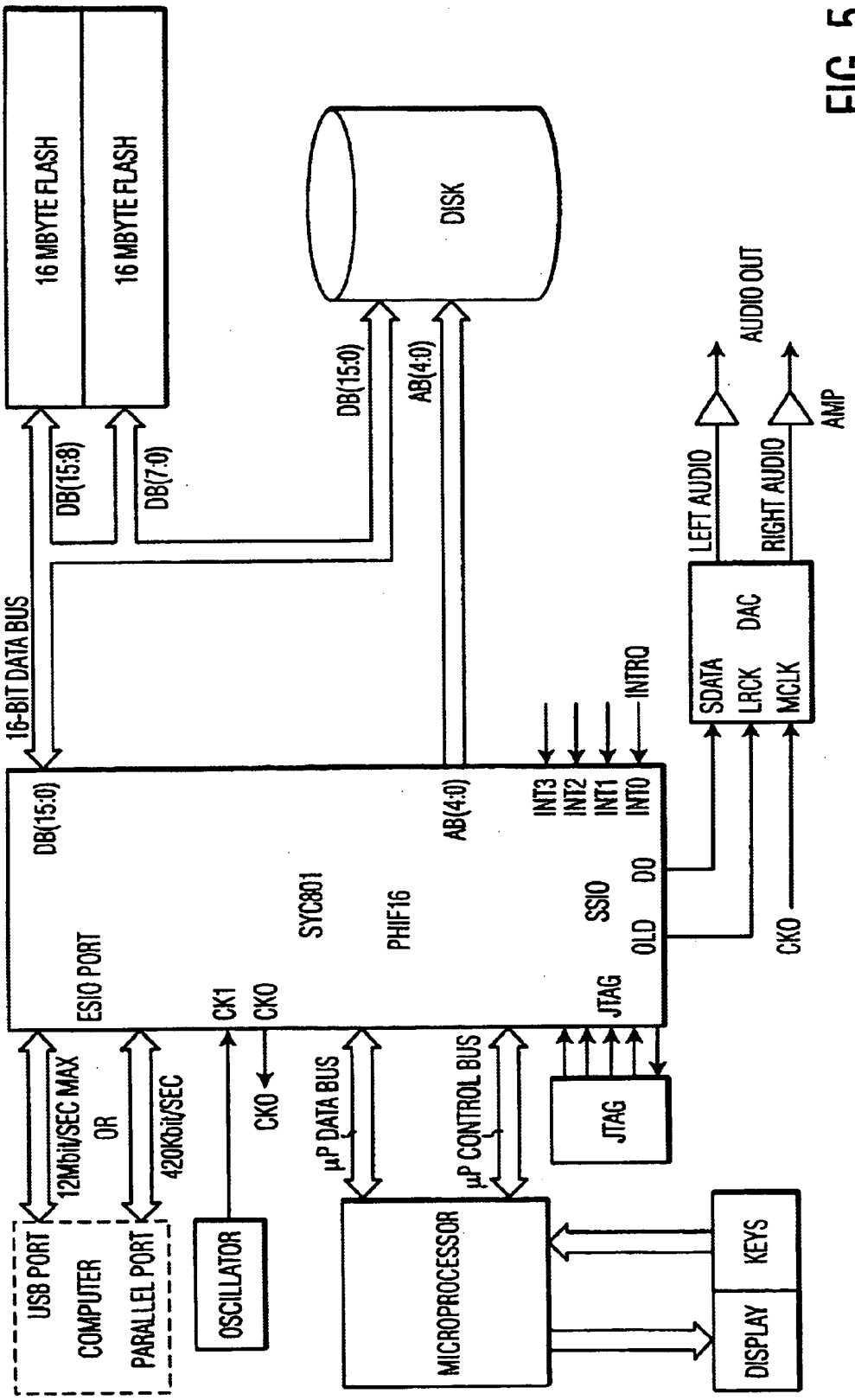

16 MBYTE FLASH
16 MBYTE FLASH
DISK
DB(15:8)
DB(7:0)
DB(15:0)
AB(4:0)
AUDIO OUT
AMP
LEFT AUDIO
RIGHT AUDIO
16-BIT DATA BUS
DB(15:0)
AB(4:0)
INT3
INT2
INT1
INT0
INTRQ
SDATA
LRCK
MCLK
DAC
SYC801
PHIF16
SSIO
DO
OLD
JTAG
ESIO PORT
CK1
CKO
CKO
µP DATA BUS
µP CONTROL BUS
JTAG
12Mbit/SEC MAX
OR
420Kbit/SEC
USB PORT
COMPUTER
PARALLEL PORT
OSCILLATOR
MICROPROCESSOR
KEYS
DISPLAY

FIG. 5

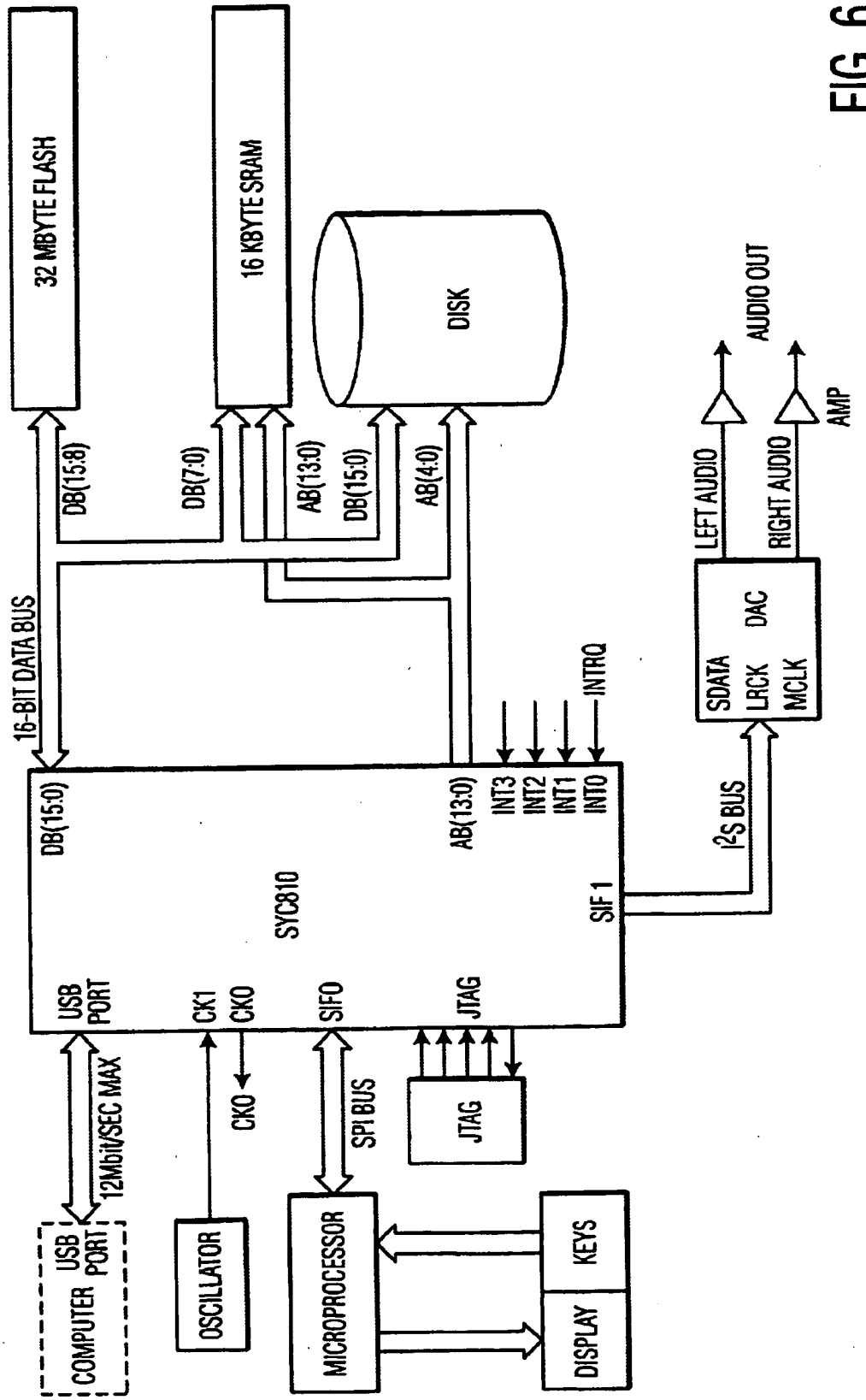

32 MBYTE FLASH
16 KBYTE SRAM
DISK
AUDIO OUT
AMP
LEFT AUDIO
RIGHT AUDIO
DB(15:8)
DB(7:0)
AB(13:0)
DB(15:0)
AB(4:0)
16-BIT DATA BUS
SDATA
LRCK
MCLK
DAC
INTRQ
DB(15:0)
AB(13:0)
INT3
INT2
INT1
INT0
I2S BUS
SYC810
SIF1
USB PORT
CK1
CKO
SIFO
JTAG
CKO
SPI BUS
JTAG
12Mbit/SEC MAX
COMPUTER USB PORT
OSCILLATOR
MICROPROCESSOR
KEYS
DISPLAY

FIG. 6

HARD DISK BASED PORTABLE DEVICE

RELATED APPLICATION DATA

The present application is a continuation-in-part application of U.S. patent application Ser. No. 09/409,531, filed Sep. 30, 1999, titled "Portable Audio Playback Unit," which relates to, and is entitled to the benefit of the filing date of, U.S. Provisional Patent Application Ser. No. 60/134,989, filed May 20, 1999, titled "Portable Audio Playback Unit" and U.S. Provisional Patent Application Ser. No. 60/129,003, filed Apr. 13, 1999, titled "Portable Audio Player."

FIELD OF THE INVENTION

The present invention relates in general to the field of portable digital devices, and in particular, to portable devices having very large requirements for storage capacity of data, such as audio/music devices, needed to play and record data, including audio, still images, video, text, and music.

BACKGROUND OF THE INVENTION

With the rapid growth of mobile computing and recent developments in digital data compression, digital devices, such as music/camera/video players and recorders, have the potential of becoming more popular. In the case of digital music players/recorders, these devices offer a better means of taking advantage of music offered on the Internet and are more resilient than drive systems having moving parts, such as CD players and MD players. In the case of digital cameras, such devices offer quick previews means with fast PC connectivity to communicate and store images. In the case of cellular phones, such devices offer a convenient means of capturing large amounts of data anywhere, anytime. In addition, as technology advances electronic devices are, in general, shrinking in size, and with them so are portable digital devices.

Unfortunately, high quality music or audio, images, and video require a large amount of digital memory. For example, even after an over 10-to-1 compression of PCM format, an hour of high quality digital music may still require 60 Megabytes of memory. In order to reduce power consumption of the portable devices most vendors typically use non-volatile memory, such as a FLASH type memory. However, this type of memory is relatively expensive and limited in capacity, and as a result no more than 128 megabytes are typically currently used. Clearly, this amount of onboard memory is not large enough to support a large library of digital data, such as text, audio, image, and video files. An average library of a typical music listener/collector today may require gigabytes of storage space.

In order to solve the storage problem, the portable devices rely, in many cases, on a hard disk of a Personal Computer (PC) for storing a large library of "records." As a result, these current devices are portable only as long as one is satisfied with very limited storage capacity for information, such as about an hour of music that has been downloaded from the hard disk of the PC to the onboard memory of the portable device, or a memory card provided with the device.

However, this limits the user to only about an hour of playtime and in order to download new digital data for use on the digital device, a PC having a hard drive with a library of "records" has to be readily available to download new records to the portable device. The problem is compounded with image data and even more so with video data.

Others have tried to solve the problem, for example, by using a mini-disk as a storage device for the library

of "records." This proposed solution was also not very effective or portable in that one still needed to have access to or carry a portable mini-disk storage box instead of a PC. Also, the CD player was required to continuously operate during music playback. This may impact negatively on the portable device's power consumption and thus its play/record times. This approach has another significant disadvantage in that there are moving parts during data play/record time.

Some vendors integrate a micro-drive into the portable device in an attempt to solve the storage capacity crunch. Although the micro-drive may have a higher capacity than available non-volatile memory, it is still limited in storage capacity (e.g., typically limited to about 350 megabytes). In addition, it is orders of magnitude more expensive relative to other mass storage devices. Furthermore, like the mini-disk, the micro-drive is continuously active when the device is on and this, as was mentioned earlier, impacts negatively on the portable device's power consumption and performance characteristics in harsh environments (e.g., shock).

Accordingly, there is a need for a small size, low-cost and power efficient solution to the high capacity storage needed for the upcoming portable digital music or audio, camera, video, and cellular phone players, and the like. Similar needs are mirrored in other markets, such as personal digital assistants and electronic books. The solutions described herein are applicable in other markets in which a portable, battery operated, relatively low cost mass storage device is needed to store relatively large amounts of data.

SUMMARY OF THE INVENTION

The above described problems associated with prior art devices and techniques for storing large amount of digital data, including for example text, audio, images, and video files, onboard of a portable device, are overcome by the present invention. The present invention is directed to a portable device that utilizes a battery operated conventional hard disk as part of the portable device. The hard drive can be either an integral or a stand-alone part of the device.

According to one embodiment of the invention, the portable device includes a player and a hard disk (e.g., a disk drive including a hard disk storage medium). Preferably, both parts are small, battery operated and portable. The hard disk preferably has a storage capacity of several gigabytes of digital data (including multimedia data, such as text, audio, image, video and/or music data, as well as program files). The player will typically have electronics to play or display the digital data files, local non-volatile memory to store a limited amount of playtime data, and peripheral devices to record and play text, audio/music, still images, and/or video. The player can include, for example, a music playback device for playing and recording audio information, a digital photography camera for playing and recording still image photography information, a digital video camera for playing and recording video information, a cellular phone for playing and recording audio information, etc.

To improve the portability of the device, it can be designed as two independent parts including the hard drive unit and the player unit. This allows the player unit to be detached and carried separately from the hard drive unit once the player on-board memory has been loaded with data for a period of playtime. In this embodiment, the player device is far more durable and resilient to shock. Accordingly, the present invention provides all the advantages of a portable chip memory based device with the advantage of immediate and in-the-field access to large volumes of data.

In accordance with another aspect of the invention, the hard disk and the player form an integral portable device, preferably having player and disk drive electronics that are integrated on the same circuit substrate, such as a printed circuit board (PCB). The typical electronics for managing the data on a hard drive are integrated with the recording, playing or displaying electronics. In addition, certain electronic components may be shared by the hard disk controller and player electronics, thus further reducing the cost and size of the portable device. This creates a more tightly integrated solution that benefits from further power consumption reduction, lower cost and smaller size.

In some cases, the preferred requirements for managing the data on the hard drive can be relaxed if the application is only for audio, images, or video, since the file sizes are generally large and continuous over sectors of the memory. The hard disk electronic controller and electronic circuitry can be simplified and a smaller (and cheaper) chip having less cache memory can be used. Under such circumstances, the electronics can be simplified and further reduction can be achieved in power consumption and cost. Also, file descriptions, including for example header information, song titles, image descriptions, etc. can be uploaded from the hard disk to the non-volatile memory so that the user can review and select items for use on the player without accessing and running the hard disk.

A further embodiment within the scope of the present invention is directed to a method of playing digital data on a portable handheld device. The method of playing data on the portable handheld player includes storing digital data on a hard disk of a portable device as one or more data files, transferring the data files to a non-volatile memory of the player device, and processing the data on the non-volatile memory with digital electronics to produce digital signals. During the playback period, the disk can be detached, turned off, and/or placed in a locked state to both reduce power requirements and also the vulnerability to shock. In addition, the method of playing data can include retrieving the digital data to be stored on the hard disk from an external communications device that is coupled to the hard disk.

In another embodiment, the present invention includes a method of recording data on a portable handheld device. This method includes converting an analog (music/audio/image/video/text) signal to digital data, processing a digital bit-stream with digital electronics capable of processing the data to produce digital signals, and storing the digital data on the player's non-volatile memory or directly to the hard disk of the portable device as one or more files. In addition, the method of recording data on the portable handheld device can include retrieving the data to be converted from an external communications device coupled to the digital electronics.

In another embodiment, the present invention includes a method of downloading data to a portable handheld device having a dedicated hard drive and player. The method for downloading data includes coupling the portable handheld device to an external communications device, selecting one or more data and program files for download, downloading the selected data and program files from the external communications device to the portable device, and storing the downloaded data and program files in a disk storage medium of the hard disk of the portable device.

In another embodiment, file descriptions, such as the name of song titles or image descriptions, are collectively transferred to the non-volatile memory of the player. In this manner, the selection, organization, and other manipulations of the files can be accomplished without accessing and running the hard disk. Once the task is complete, the hard disk can be accessed and all the requirements implemented in a relatively short period of time.

Voice recordings can be attached to images to assist in the organization and retrieval of the images.

BRIEF DESCRIPTION OF THE INVENTION

The foregoing and other aspects of the present invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings. For the purpose of illustrating the invention, there is shown in the drawings embodiments that are presently preferred, it being understood, however, that the invention is not limited to the specific methods and instrumentalities disclosed. In the drawings:

FIG. **1** shows top and side views of an exemplary portable device having a detachable hard disk in accordance with the present invention;

FIG. **2A** is a high-level block diagram showing an exemplary data-flow for the device of FIG. **1** in accordance with the present invention;

FIG. **2B** is another high-level block diagram showing an exemplary data-flow for the device of FIG. **1**;

FIG. **3** is a top and side view of another exemplary portable device having an integrated hard disk in accordance with the present invention;

FIG. **4A** is a high-level block diagram showing an exemplary data-flow for the device of FIG. **3** in accordance with the present invention;

FIG. **4B** is another high-level block diagram showing an exemplary data-flow for the device of FIG. **3**;

FIG. **5** is a block diagram showing the exemplary player device of FIGS. **1** and **3**; and

FIG. **6** is a block diagram showing another exemplary player device.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The present invention is directed to a hard disk based portable handheld device that provides for storing relatively large amounts of digital data and/or program files on the portable device using the hard disk. The portable handheld device includes a player for playing/recording data, such as audio and music, and a hard disk (e.g., a disk drive including a hard disk storage medium) for storing relatively large amounts of data that can be used by the player. Preferably, the hard disk has a storage capacity of several gigabytes of digital data (including multimedia data, such as text, music, video and/or audio data, as well as program files). The present invention was developed in part to provide a small size, low-cost, and power efficient portable device having a high storage capacity.

The following section refers to FIGS. **1** and **2** in describing the embodiment of the invention in which the player and hard disk that form the portable device are selectively detachable from one another. FIGS. **3** and **4** are referred to in describing the embodiment in which the player and hard disk are integrated (e.g., not detachable) into a single housing of the portable device. Preferably, but not necessarily, the integrated portable device has a single substrate for supporting the player and hard disk controller electronics. The remaining sections of this detailed description refer to FIGS. **5** and **6** and relate to further details of the architecture of an exemplary portable device.

Portable Device With Detachable Hard Disk

FIG. 1 shows a high-level block diagram of the portable device according to one embodiment of the present invention. As shown in FIG. 1, the portable device 1 comprises two main parts, the portable player 2 and the hard drive 3. The processor 4 prepares the digital data, usually requiring a decompression process, for the D/A converter 20 on the player 2, which in turn converts the digital data from digital format into analog signals. Those signals can then be sent to earphones 5, or alternatively, connected directly to other stand-alone audio amplifiers 6 and external speakers. In the case of a camera or video, the processor 4 would be preparing the digital image for the digital to optical converter, which would finally be projected on a display.

In addition, an A/D converter 21 can convert the audio signal from a microphone 7 or other audio input and transfers the digitized signal to the processor 4. The digital data is preferably compressed in the processor 4 to reduce the memory requirements of the data. The digital data is stored on an onboard memory 8, preferably non-volatile memory, such as a FLASH-type memory.

Preferably, control buttons 15 on the portable device 1 allow for operation of the player 2 and its interface with the hard disk 3 via an interface 9, which can be a physical hard connector or a wireless interface. The portable device 1 can also have an interface 10 to allow data-file download/upload from an external communications device 11, such as a PC, to the portable device hard disk 3. Interface 10 can be a physical hard connector or a wireless interface. The portable device can also include an interface to, for example, a media card 13, which can be available as an additional or alternative on-board memory unit.

The hard disk 3 is preferably a PC style hard disk, such as an ATA-type hard drive. The dimensions and weight of such a hard drive 3 would be suitable for portable applications. The preferred dimensions would be approximately 110 mm×70 mm×10 mm and its weight approximately less than 100 g. These preferred dimensions currently represent the smallest hard disk available that has achieved the desired low cost per megabyte is this size. As new smaller drives having comparable, or smaller, size and cost become available they may be used with the present invention. Furthermore, like a conventional hard drive, the hard drive 3 is preferably capable of uploading and downloading data very rapidly (e.g., about 12 seconds for 32 megabytes of data), the limitation being the speed of the on-board memory. As a result it is possible to rapidly download hours or more of data, such as audio, to the player for playback. After the data has been downloaded, the hard disk can be detached and removed during playtime.

Referring to FIG. 1, the two main parts of the portable device 1 (e.g., the player 2 and hard disk 3) can be detachably connected (e.g., selectively attached and detached) with a special, easy to engage connector at interface 9, or alternatively a wireless type of interface, to facilitate the upload/download process. Preferably, the hard disk is an independent unit that is dedicated to storing data and programs for use by the player. In other words, the hard disk is not associated with another device external to the portable device, such as a general purpose computer. This type of arrangement is very attractive because it allows the user to detach the lighter player 2 from the independent, dedicated hard disk 3.

The hard drive 3 can also include a card slot (not shown) for inserting a memory card from another device. Data/files can then be transferred from the portable device to the memory card for use with the other device. Alternatively, data/files can be transferred from the memory card to the hard disk.

The hard disk 3 in the detachable embodiment includes a hard disk housing containing a disk storage medium for storing the digital data and the necessary electronic circuitry for controlling and operating the hard disk. The electronic circuitry is disposed on a circuit substrate and is selectively operatively coupled between the disk storage medium and one of the player and an external communications device for uploading and/or downloading data. The detachable hard disk has its own power source, and is preferably battery operated. The hard disk PCB, as shown in the top view of FIG. 1, is a partial cut-a-away view with the hard disk PCB partial cut-a-way for clarity and to show the location and relationship of the disk storage medium to the PCB.

The player includes a player housing having a solid state electronic memory for use in active playback and recording and has electronic circuitry disposed on a circuit substrate for transferring data between its memory and the hard disk. The player has an interface corresponding the hard disk interface for selectively attaching and detaching the player and the hard disk. The player has an onboard power source, such as a battery, and the battery-operated player 2 can play, for example, text, audio/music, image, and video files stored on its local memory.

Preferably, the portable device 1 also includes a high-speed interface 10, such as a high-speed connection, for coupling the portable device 1 to an external communications device 11, such as a PC, for downloading of digital data from an external source to the portable device. It can also allow a PC to do the hard-disk management. The hard disk 3 can be connected, for example, through an ATA™ interface and be controlled by a PC for programs, such as for example SCANDISK™, and other hard disk utilities'programs.

In some cases, the preferred requirements for managing the data on the hard drive can be relaxed if the application is only for audio, images, or video, since the file sizes are generally large and continuous over sectors of the memory. Under such circumstances, the electronics can be simplified and further reduction can be achieved in power consumption and cost. This is accomplished by not requiring the same amount of processing power to manage the memory of the hard disk. Accordingly, the hard disk electronic controller and electronic circuitry can be simplified and a smaller (and cheaper) chip having less cache memory can be used.

FIGS. 2A and 2B are flow-charts showing exemplary methods of operation for a portable device having a detachable hard disk in accordance with the present invention. As shown in FIG. 2A, the method includes activating the portable handheld device at step 100. Preferably, although not necessarily, the player and the hard disk are attached at the start of the process. Two options are then available to the user. The user can download data from an external device, or alternatively, the user can download data from the hard disk of the portable device.

In order to download data from an external device, the portable device is attached to an external communications device, such as a PC at step 105. Data and program files can be downloaded from the PC to the portable device at step 110. The data and program files can be downloaded to a solid state electronic memory of the player, or preferably, to a disk storage medium of the hard drive. If the portable device was connected to an external communications device, then the portable device is detach from the external communications device at step 115. This can include detaching a physical connection, such as a standard wired connection, between the portable device and the external communications device, or alternatively, terminating/disconnecting a wireless con-

nection between the external device and the portable device. Alternatively, the user can download data directly from the hard disk, without accessing an external device.

The user chooses a play-list from the library of records stored on the hard disk of the portable device at step **120**. The play-list and programs are transferred at step **125** from the hard disk to the player device. Preferably, this transfer includes the transfer of digital data from the disk storage medium of the hard disk to the FLASH memory or other memory of the player. Also, header information for the data and each data file can be uploaded from the hard disk to the non-volatile memory so that the user can review and select items for use on the player without accessing and running the hard disk. Preferably, data is transferable between the memory of the player and the disk storage medium of the hard disk. The hard disk is powered down at step **130**.

The player is then detached from the hard disk at step **135**. The user can use the player to play the play-list at step **140**. When the user desires to modify or add to the current play-list, the user attaches the player to the hard disk at step **145**. This includes physically re-attaching the player to the hard disk. Again, the user can either download data from an external device or directly from the hard disk of the portable device.

As shown in FIG. **2B**, it is preferred that the file descriptions, such as the name of song titles or image descriptions, be collectively transferred from the hard disk to the non-volatile memory of the player. Accordingly, step **117** is added to the process shown in FIG. **2A** and the file descriptions, such as the play-list titles, are transferred from the hard disk to the on-board memory of the player. The hard disk is then detached from the player at step **118** and the user can review and select a play-list at step **120**. After a play-list is chosen, the player is attached to the hard disk at step **122** and the play-list is transferred from the hard disk to the player at step **125**. In this manner, the selection, organization, and other manipulations of the files can be accomplished without accessing and running the hard disk. Once these tasks are complete, the hard disk can be accessed and all the requirements implemented in a relatively short period of time. The hard disk can then be powered down at step **130**, detached from the player at step **135** and the play-list can be played at step **140**.

Portable Device With Integral Hard Disk

FIG. **3** shows another embodiment of the present invention wherein the portable device has an integrated hard disk. Referring to FIG. **3**, the portable device's two main elements, the player **2** and the hard disk **3**, are integrated into the same housing of the portable device (e.g., the portable device has a single housing and the player and the hard disk are not detachable). Preferably, but not necessarily, the integrated portable device has a single substrate for supporting the player and hard disk controller electronics. Thus the hard-disk controller, the player's electronics and memory are built on the same board **14**. This allows a higher level of integration that leads to lower cost and a smaller portable device **1**. In this configuration as well, the hard disk **3** can include an interface **10** for connecting the hard disk **3** directly to a PC (not shown) for data down-up loads and for other disk management utilities. Preferably, the player and the hard disk share common electronics, such as for example, a DSP, a memory, a micro-controller, etc.

The preferred single circuit substrate includes a solid state electronic memory for use in active playback and recording, wherein data, such as audio information, is transferred from the hard disk to the memory and then the hard disk is deactivated or placed in a locked state. Electronic circuitry for the player and the hard disk is selectively operatively coupled between the disk storage medium and either the player or an external communications device for uploading/downloading digital data between the hard disk and either the player or the external communications device. In addition, the electronic circuitry is selectively operatively coupled between the hard disk and the memory for playback of data, such as audio information, from the memory. At least one power source is provided in the housing for providing power to the player, the hard disk, and the electronic circuitry for operating the portable device.

In this embodiment having an integrated player and hard drive, the hard drive is preferably deactivated and/or placed in a locked state once the data has been transferred from the hard disk to the player memory (e.g., the hard disk is locked or turned off prior to and during playtime). The portable handheld device can include a deactivation mechanism for selectively turning off or locking the hard disk during playtime and allowing the hard disk to operate again when read/write access is required.

FIGS. **4A** and **4B** are a flowcharts showing a method of operation for the exemplary portable device of FIG. **3** having an integral hard disk and player. As shown in FIG. **4A**, the method includes activating the portable handheld device at step **150**. Two options are again available to a user, the user can download data from and external device to the portable device at step **160**, or alternatively, the user can transfer data from the hard disk of the portable device to the memory of the player at step **170**.

To download data from an external source, the portable device is attached or coupled to an external communications device, such as a PC, at step **155**. Data and program files can be downloaded from the external communications device to the portable device at step **160**. The data and program files are downloaded the disk storage medium of the hard drive. After downloading the data, the portable device is detached from the external communications device at step **165**. This can include detaching a physical connection, such as a standard wired connection, or alternatively, terminating a wireless connection between the portable device and the external communications device.

The user can choose a play-list from the library of records stored on the hard disk of the portable device at step **170**. Note that the user does not have to download data from an external source prior to choosing the play-list. The play-list and programs are transferred at step **175** from the hard disk to the player device. Preferably, this transfer includes the transfer of digital data from the disk storage medium of the hard disk to the FLASH memory or other memory of the player. In addition to data relating to the play-list, header information for the data and each data file can also be uploaded from the hard disk to the non-volatile memory so that the user can review and select items for use on the player without accessing and running the hard disk. The hard disk is powered down at step **180**.

The hard disk is locked/de-activated (e.g., turns power off) at step **185** such that it does not operate during playtime. The user can use the player to play the play-list at step **190**. When the user desires to modify or add to the current play-list, the user unlocks/re-activates (e.g., turns power on) the hard disk.

The user can choose a new or modified play-list from the library of records stored in the disk storage medium of the hard disk at step **170**. Alternatively, the user can attach the portable device to an external communications device at step **155** and then download data and program files from the external communications device to the portable device at step **160**.

As shown in FIG. 4B, it is preferred that the file descriptions, such as the name of song titles or image descriptions, be collectively transferred from the hard disk to the non-volatile memory of the player. Accordingly, step **167** is added to the process shown in FIG. 4A and the file descriptions, such as the play-list titles, are transferred from the hard disk to the on-board memory of the player. The hard disk is then de-activated (e.g., turned off or placed in a locked state) from the player at step **168** and the user can review and select a play-list at step **170**. After a play-list is chosen, the player is re-activated (e.g., turned on or unlocked) to the hard disk at step **172** and the play-list is transferred from the hard disk to the player at step **175**. In this manner, the selection, organization, and other manipulations of the files can be accomplished without accessing and running the hard disk. Once the task is complete, the hard disk can be accessed and all the requirements implemented in a relatively short period of time. The hard disk can then be powered down at step **180**, de-activate/locked from the player at step **185**, and the play-list can be played at step **190**.

An exemplary process for playing digital data and program files on the exemplary portable devices of FIGS. 1 and 3 includes:

(a) Downloading data and files that are needed to operate the portable device **1** from an external communications device **11** to the hard disk **3**. The data and files can be downloaded using any standard download technique and can be accomplished wirelessly, or wired directly to the external communications device **11** that is coupled to a server having stored data and program files. The external communications device **11** can include, for example, a host computer, a cable set-top box, the Internet, an Intranet, a modem, etc. In some instances an IDE connection to a PC may be advantageous since the PC views the device as a standard hard drive thereby making file transfers very simple and fast.

(b) Downloading selected files and programs from the hard disk **3** to the player's onboard memory **8**.

(c) Processing the data files with the dedicated processor **4** and electronics on the player **2** to create analog audio/music signals and directing them to one or more of the earphone/speaker **5,6** output.

An exemplary recording process is generally the converse of the playing process, and includes:

(a) Digitizing an analog signal with an electric circuit.

(b) Processing the digitized data using the dedicated processor **4** and electronics and temporarily storing the processed data on the onboard memory **8**.

(c) Uploading the stored data to the portable device hard disk **3** for permanent storage.

An exemplary method of downloading data to the portable handheld device having a dedicated hard drive and player includes:

(a) Coupling the portable handheld device **1** to an external communications device **11**.

(b) Selecting one or more data and program files for download.

(c) Downloading the selected data and program files from the external communications device to the portable device.

(d) Storing the downloaded data and program files in a disk storage medium of the hard disk of the portable device.

During the download process, it is possible to download part of each data file into the player memory. The download process can also include downloading/uploading data and/or program files between the hard disk and the onboard memory during one of data playing and data recording. In addition, the method can also include downloading/uploading data and/or files between the hard disk and the external communications device during one of data playing and data recording.

The use of the hard disk with a portable device and the described method of operation provide for the following important advantages:

1. Lowest onboard per byte storage cost among all current mass storage devices.
2. Power consumption is minimized because hard-drive operation is not needed during play/record times. During continuous operation the hard disk typically draws about 300 milli-amperes and during initialization it draws about 2 amperes. As a result 2 AA batteries can support more than 150 half-hours of uploads or downloads to the onboard non-volatile memory.
3. There are no moving parts during playtime. So there is no need to over-protect the device from vibration and shock that may cause skips.

Architecture of Portable Handheld Player

The player can include, for example, a music playback device for playing and recording audio information, a digital photography camera for playing and recording photography information, a digital video camera for playing and recording video information, a cellular phone for playing and recording audio information, etc. The below description related to an exemplary portable handheld audio playback unit for playing and recording of music and audio data. Other devices that can comprise the player include standard devices and therefore are not described in detail because they are well known in the art.

In one exemplary embodiment of the present invention, the portable handheld device is a Portable Audio Playback Unit, in which audio content can be written, stored, retrieved, and played. In addition, the unit can intelligently interact with the user, displaying non-audio information, accepting input from the user through a keyboard interface, and collecting statistics on the unit's usage.

FIGS. **5** and **6** depict alternative exemplary embodiments of the portable device. The significant difference between the two embodiments is that one employs a Static Random Access Memory (SRAM), while the other does not. This, and other differences, are a matter of economics and availability of devices, and do not affect the overall function of the unit. Accordingly, the descriptions that follow relate to either block diagram as appropriate.

One particularly important aspect of the present invention is the use of a hard drive (such as the kind typically used in a laptop or notebook computer), which is a delicate and high power consuming device. Therefore, to use a hard drive in a portable, hand-held audio player, it was necessary to find a way to both protect and reduce the power consumption of the hard drive.

In particular, the hard drive is subject to breakage if operated while the device is not stationary. This poses a significant problem for a portable, typically hand-held, device. In the present invention, the ease of breakage was dealt with in two ways: First, a careful mechanical study was conducted to find the thickness of a reasonably available absorption material needed to be used to pass a 1 meter drop test. It was discovered that about 0.8 inches of such material was sufficient to protect the hard drive. Second, a secondary stationary memory concept was used as the active system during playback or recording. Here, the hard drive uploads

an hour or so of material to the solid state memory and locks the drive. This process takes about 7 seconds. Thus, the disk medium is normally locked, especially while the unit is being carried about by the user.

The aforementioned power consumption problem was solved using the secondary memory as well, since the drive only needs to spin momentarily.

The various components of the exemplary portable devices shown in FIGS. **5** and **6** will now be described.

Communications Device

This device is external to the subject portable audio device, and is shown for clarity and completeness. When the portable handheld audio device is attached to the communications device, such as for example a computer, communication between the two can be achieved. Such communication may be done via a parallel port, a serial port, ATA bus, or any other convenient means. Through this port, digital data, including both audio and non-audio content, can be downloaded to the portable handheld audio device, and device usage statistics can be uploaded. If the portable handheld audio device is used as a recorder, this port can be used to upload the recorded content to the computer. Alternatively, the communications device can include a set-top box, a personal computer, a wireless modem link, a direct modem link, etc.

SYC801/SYC810

The components labeled SYC801 and SYC810 in FIGS. **5** and **6** are each a Digital Signal Processor (DSP) (although the invention may employ any suitable type, not only those types explicitly shown), in which the major program for the overall operation of the portable handheld audio device executes. The functions of this program are manifold, and include communication with the computer, reading/writing data from/to the Flash and Disk memories, compressing and decompressing audio data, and communicating with the microprocessor and computer.

OSC

This Oscillator supplies the clock necessary for the operation of the DSP, and may be set at any convenient frequency, not just the 12.2880 MHz explicitly shown.

Microprocessor/Display/Keys/Buttons

The microprocessor executes a program that interprets key depressions from the user, and provides visual feedback and prompts on the display. In addition, the microprocessor program contains a clock function, by which messages and prompts keyed to date and/or time can be activated without burdening the DSP, since the DSP typically requires more power for this function.

Flash Memory

Flash memory is a non-volatile storage medium. Audio data can be loaded into Flash memory and the power subsequently removed to conserve energy. When the audio data is needed, power can be restored, and the data quickly accessed. Note that the secondary memory is not limited to Flash memory, as SRAM, DRAM and other types of solid state memory may also be used.

Hard Drive

Disk memory is another non-volatile storage medium. It is economical to store vast quantities of audio data on the Disk, ready for transfer to the Flash memory for quick processing as directed by the DSP.

As discussed above, an important aspect of the present invention is the use of a hard drive (such as the kind typically used in a laptop or notebook computer), which is a delicate and high power consuming device. Therefore, to use a hard drive in a portable, hand-held audio player, the hard drive must be protected and its power consumption must be reduced. In accordance with the present invention, the hard drive may be subject to breakage if operated while the device is not stationary. This poses a significant problem for a portable, typically hand-held, device. This is one reason why hard drives have never been used for portable devices. Another reason is because they were not built for that purpose. However, hard drives have one clear advantage over other media in that they are very mature technology and therefore have ridden far down the price performance curve. In the present invention, the ease of breakage was dealt with in two ways. First, a careful mechanical study was conducted to find the thickness of a reasonably available absorption material needed to be used to pass a 1 meter drop test. It was discovered that 0.8 inches of such material is sufficient to protect the hard drive. Second, a secondary stationary memory concept was devised to be used as the active system during playback or recording. Here, the hard drive uploads an hour or so of material to the solid state memory and locks the drive. This process takes about 7 seconds. Thus, the disk medium is normally locked, especially while the unit is being carried about by the user.

With regard to the absorption material, it should be noted that we have not yet identified the best material to use. We have determined that the properties for such a material are to absorb a high impact and also to provide a loose enough motion for normal motion. It is analogous to a car wheel suspension system but more complicated since it needs to perform 360 degrees. In a car, one needs to prevent damage from high impact and also to have a smooth ride over small bumps. These are competing constraints. There are many materials that may provide this but none have been selected yet. It may end up being a combination of a few. The measurements we performed were to define that deceleration needed to prevent the hard drive from breaking. This in turn allows for the definition of the types of materials we need.

Also, the playback unit can be designed so that the hard drive can be disconnected from the playback unit. Accordingly, the unit can operate independently in case the user wants to use the device in a particularly harsh environment or to reduce the weight and size of the product for easier mobility.

The hard drive can interface with an external communications device, such as a personal computer (PC), in a number of ways, including for example: (1) through an IDE interface that is very fast and acts as an external drive for the PC; (2) through a USB (Universal Serial Bus) interface; and (3) through a parallel port interface. Other means of communication are also possible.

Other advantages of using a hard drive include:

- The hard drive can be changeable to upgrades in memory size as the densities grow.
- The volume of audio for the cost of the unit it the biggest novelty, using a mature technology, hard drive, for the purpose of providing an abundance of audio.
- Compression algorithms, such as MP3, are used to maximize the amount of audio for the amount of memory (typically, 100 kbit per minute) at CD-like quality.
- We propose to use the 2.5" laptop-type drive since it is inexpensive and designed for relative durability. However, smaller drives may make more sense in the future.
- The present invention is also advantageous in high volume recording applications. One issue with portable digital recorders is that memory is expensive, and so time is relatively limited. The use of a high capacity hard drive remedies this problem.

The present invention may also be expanded to video and digital cameras.

The algorithms can be loaded from the hard drive to offer different algorithms in the future.

SRAM

It may be convenient and economical to store some of the DSP's program external to the DSP itself. This Static Random Access Memory is intended for that purpose, although DRAM may also be used.

DAC

Audio data, after being decompressed or otherwise manipulated by the DSP, is presented to this Digital-to-Analog Converter (DAC). The digital data, in conjunction with various clocking signals, is converted to a smoothly-varying analog signal representative of the intended sound. In addition, separation of Left and Right Audio signals takes place within the DAC.

AMP

The audio signal is Amplified to a level suitable for speakers or headphones.

Other Applications

Audio can be downloaded from the Internet, stripped from personal CDs (compact disks) and loaded into the hard drive, and/or recorded and ported to the hard drive. In addition, a wireless interface to the unit can offer a way to transfer audio/video (AV) information.

The inventive device may also be used in an automobile. For example, the unit can be built into an auto panel system and audio can be ported to the unit in a number of ways: (1) audio can be loaded onto the unit's hard drive by a portable PC; (2) the hard drive can be removed and interfaced to a PC for loading of the audio; (3) the audio can be recorded from the automobile's radio; and/or (4) dictation can be taken in the car using a microphone.

Although illustrated and described herein with reference to certain specific embodiments, it will be understood by those skilled in the art that the invention is not limited to the embodiments specifically disclosed herein. Those skilled in the art also will appreciate that many other variations of the specific embodiments described herein are intended to be within the scope of the invention as defined by the following claims.

What is claimed is:

1. A portable handheld device comprising:

a player capable of recording and playing digital data; and

a hard disk removably coupled to said player for storing said digital data, said hard disk being configured to transfer data from said hard disk to said player, wherein said hard disk is not associated with a general purpose computer; and

wherein said player is configured to allow the data transferred from the hard disk to be selected and to play the selected transferred data when the hard disk is not coupled to the player.

2. The portable handheld device of claim **1**, wherein said hard disk further comprises an interface connection, said interface connection communicating with an external communications device to allow data and file download/upload between said hard disk and said external communications device.

3. The portable handheld device of claim **1**, wherein said hard disk further comprises

a hard disk housing;

a disk storage medium disposed in said hard disk housing for storing digital data;

electronic circuitry disposed on a circuit substrate in said hard disk housing, for uploading/downloading digital data between said hard disk and one of said player and/or an external communications device;

an interface in said hard disk housing for detachably connecting said hard disk to said player; and

a power source disposed in said hard disk housing, said power source being coupled to said electronic circuitry for operating said hard disk.

4. The portable handheld device of claim **3**, wherein said power source comprises a battery.

5. The portable handheld device of claim **1**, wherein said player further comprises:

a player housing;

a solid state electronic memory disposed in said player housing for use in active playback and recording, wherein said data is transferable either from said hard disk to said memory or between said hard disk and said memory before said hard disk is detached form said player;

electronic circuitry disposed on a circuit substrate disposed in said player housing, for playback of said data from said memory;

an interface in said player housing for detachably connecting said player to said hard disk; and

a power source disposed in said player housing, said power source being coupled to said electronic circuitry for operating said player.

6. The portable handheld device of claim **5**, wherein said power source comprises a battery.

7. The portable handheld device of claim **1**, wherein said hard disk can be coupled to an external device for data and hard disk management.

8. The portable handheld device of claim **1**, wherein said player is a music player and said data comprises audio information.

9. The portable handheld device of claim **1**, wherein said player is a digital photography camera and said data comprises digital optical image information.

10. The portable handheld device of claim **1**, wherein said player is a digital video camera and said data comprises digital video information.

11. The portable handheld device of claim **1**, wherein said player is a cellular phone and said data comprises audio information.

12. The portable handheld device of claim **1**, wherein said files have file sizes that are generally large and continuous over sectors of memory thereby requiring less processing power to manage said memory of said hard disk, and wherein said hard disk electronics are simplified and said hard disk electronic controller comprises a smaller chip having less cache memory.

13. The portable handheld device of claim **1**, wherein file descriptions are collectively transferable to said non-volatile memory of said player, and wherein one or more of a selection, an organization, and other manipulations of said files can be accomplished without accessing and running said hard disk.

14. The portable handheld device of claim **13**, wherein once said selection, organization, and other manipulations of said files is complete, said hard disk can be accessed and said selected files can be transferred in a relatively short period of time.

15. The portable handheld device of claim **1**, wherein voice recordings can be attached to said data to assist in organization and retrieval of said data.

16. The portable handheld device of claim **1**, further comprising a card slot formed in said portable device and

coupled to said portable device electronics, said card slot constructed to receive a memory card that can be inserted into said card slot for transferring data between said portable device and said memory card.

17. A method of playing digital data on a portable handheld device having a dedicated hard disk and player comprising:

storing digital data on said hard disk of said portable device as one or more data files;

allowing a portion of the digital data on said hard disk to be selected for transfer to said player device;

transferring only said selected data filed to a non-volatile memory of said player device;

detaching the hard disk from the portable device; and

processing said selected data in said non-volatile memory with digital electronics to produce digital signals when the hard disk is detached from the portable device.

18. The method of claim **17**, further comprising storing programs used to play said digital data on said hard disk.

19. The method of claim **18**, wherein said programs are used to play one of compressed and uncompressed data.

20. The method of claim **17**, further comprising uploading file header information for said data to said non-volatile memory for use in reviewing and selecting items from said player memory.

21. The method of claim **17**, wherein said hard disk is used as a general-purpose storage device.

22. The method of claim **17**, further comprising retrieving said digital data to be stored on said hard disk from an external communications device coupled to said hard disk.

23. The method of claim **17**, further comprising disconnecting power to said hard disk when said hard disk is not in use.

24. The method of claim **17**, further comprising placing said hard disk in a locked state during playtime and unlocking said hard disk when read/write access is required.

25. A method of downloading data to a portable handheld device having a detachable hard drive and player comprising:

coupling said portable handheld device to an external communications device while said hard drive is detached from the player;

selecting one or more data and program files for download;

downloading said selected data and program files from said external communications device to said portable device;

attaching said hard drive to the player; and

storing said downloaded data and program files in a disk storage medium of said hard drive.

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